ACS
Chemistry for Life™

Nomenclature, Terminology, and Symbols

March 10, 2015

Dear Members, Associates, Consultants, and Friends of the ACS Committee on Nomenclature, Terminology, and Symbols:

Welcome to Denver and the ACS Spring national meeting. Four subcommittees are reporting on their action items and projects.

- Communication/Outreach – Robert Yokley (chair)

  Subcommittee meets 12:30-2:00pm, Hyatt Regency at CCC, Agate B (see map next page)

- Education – Paul Karol (chair)
- Liaison – chair replacement requested
- Long Range Planning – Michael Mosher/Tracy Williamson (co-chairs)

  Subcommittee meets 12:30-1:45pm, Hyatt Regency at CCC, Centennial H (see map)

The full committee membership meets:

Monday, March 23, 2015

Executive Session 2:00-5:00pm

Hyatt Regency at the Colorado Convention Center

Centennial H (see map)

Thank you in advance for all your hard work and careful planning for the Committee and for the Society.

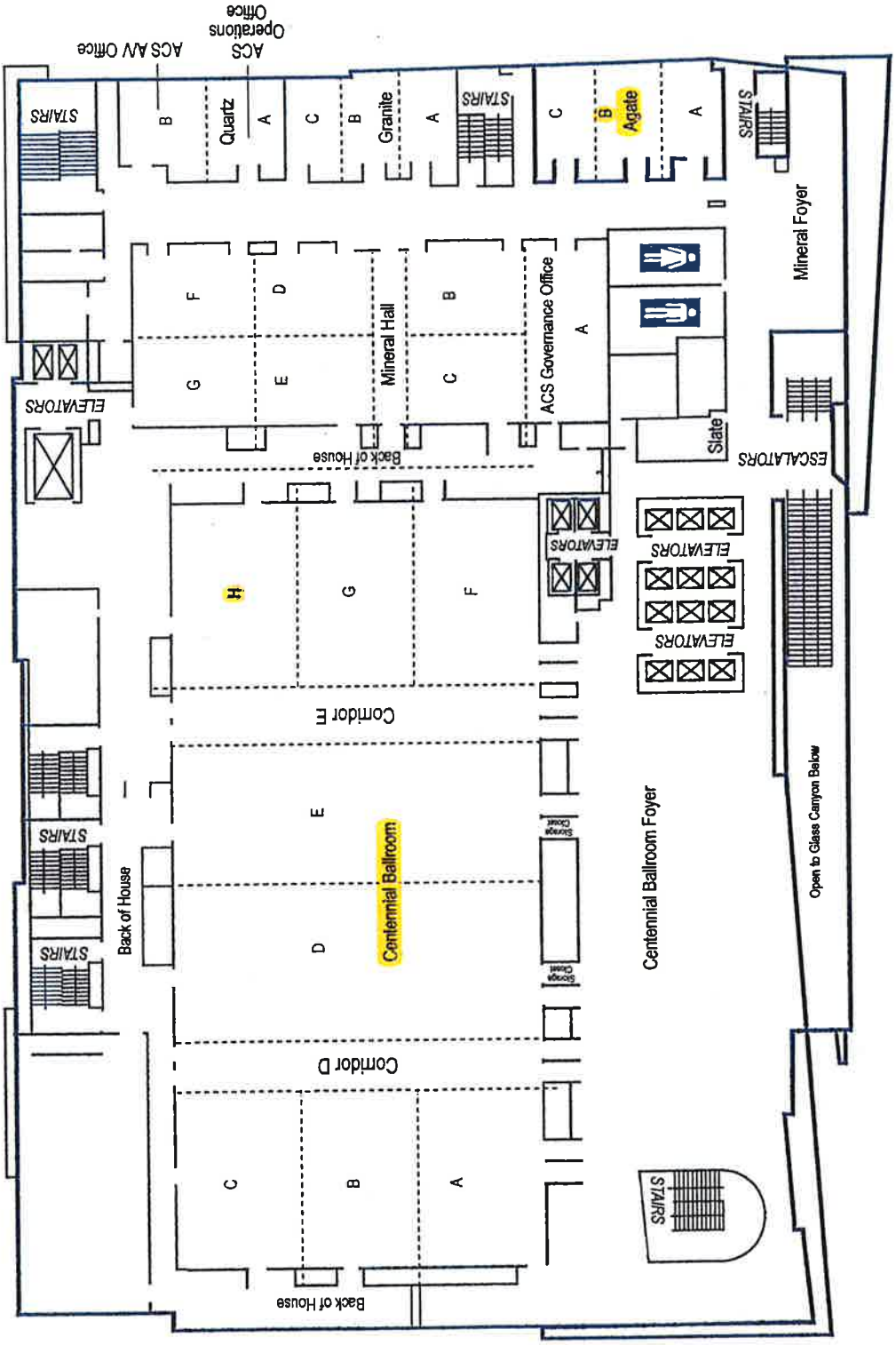
Sincerely,

Jerry

Gerald P. Fenske
Staff Liaison
ACS Committee on Nomenclature, Terminology, and Symbols
(614) 447-3600 Ext. 3102
gfenske@cas.org

HYATT

Level Three



Request from the secretary

Anyone presenting a report at the NTS committee meeting this month is requested to prepare and bring to the meeting a written executive summary with the important points that the presenter wants included in the meeting minutes.

Thank you for your thoughtfulness.

Please note that the next ACS Fall national Executive meeting is in Boston, Monday, August 17, 2015

American Chemical Society
Al Censullo, Chair
Gerald P. Fenske, Staff Liaison

AGENDA

Agenda for Executive Meeting
of
Nomenclature, Terminology, and Symbols Committee

Monday, March 23, 2015
Executive Session 2:00-5:00 pm
Hyatt Regency at the Colorado Convention Center
Centennial H room

1. Welcome and Introductions
2. Review minutes from San Francisco national meeting
3. Reports of Chair/Staff Liaison (Al Censullo, Jerry Fenske)
4. Reports from Subcommittees
    a. Communication/Outreach (Chair, Robert Yokley)
    b. Education (Chair Paul Karol)
    c. Liaison (Chair)
    d. Long Range Planning (Co-Chairs: Tracy Williamson and Michael Mosher)
5. IUPAC Reports (Derek Horton, Warren Powell)

BREAK

6. Presentation on Personalized Delivery of Information (Bill Carroll, Robert Rich)
7. Update to Kilogram, Amount of Substance and Mole issues (Paul Karol)
8. Task Force on new SI definitions (Carmen Giunta)
9. NTS Plans for Boston CCQM Symposium (Peter Rusch)
10. Other topics from the floor
11. Next Meeting: Boston, August 17, 2015
12. Adjourn

American Chemical Society

Al Censullo, Chair

Gerald P. Fenske, Staff Liaison

MINUTES OF THE MEETING OF THE ACS COUNCIL COMMITTEE ON NOMENCLATURE, TERMINOLOGY, AND SYMBOLS (NTS) IN SAN FRANCISCO, CA, ON AUGUST 11, 2014

OPENING ITEMS: At 2:04 p.m. the open meeting of NTS was called to order by chair Albert Censullo, who thanked the members who contributed to the morning symposium, organized by NTS, on "Redefinition of Mole and Kilogram: Implications for Chemists." The issue of accessibility of the minutes of NTS meetings, *i.e.*, whether portions will be restricted to NTS members (suggested at the last meeting), was raised and discussed briefly, but no action was taken. The agenda and minutes of the previous meeting were approved.

According to the attendance check-list, 36 persons were present: 32 on the committee roster, and four visitors. ***Attendees:*** David Ball, Mark Benvenuto, Elise Ann Brown, Janet Bryant, Albert Censullo, Ben Chastain, Paul De Bièvre*, Jetty Duffy-Matzner, Gerald Fenske, Mark Freilich, Carmen Giunta, Richard Hermens, Derek Horton, Bob Howell, Kathryn Hughes, Paul Karol, Risto Laitinen*, Donald MacLean, Michael Mosher, Graham Peaslee, Donivan Porterfield, Daniel Rabinovich, Jeffrey Rahn, Michelle Rogers, Peter Rusch, Jerry Sarquis, Jack Secrist, Michael Sheets, Jason E. Schaff*, Marcy Towns*, James Traynham, Tracy Williamson, Jeffrey Wilson, Leslie Sperling, Wayne Wolsey, and Robert Yokley. (* = visitor)

Changes in roster addresses: Telephone number for Karol, (412)478-9216; USPS address for Secrist, 7140 Nollar Road, Whitmore Lake, MI 48189; telephone number for Sheets, (903)823-3359; add telephone number for Wolsey, (651)696-6352.

REPORTS:

NTS report to Council: Censullo commented briefly on his pending report for the ACS Council on August 13. It contained summaries of the half-day mole-kilogram symposium, a "current awareness" program to educate and inform scientists on today's important issues in nomenclature, and the committee's new outreach activities with other units of the Society.

Budget: Gerald Fenske, Staff Liaison, presented the 2014 budget for information. It will be amended to specify allocation for the expenses associated with the

mole-kilogram symposium in San Francisco.

Report about meeting of CCQM: The Consultative Committee on Amount of Substance—Metrology in Chemistry and Biology is a part of the International Bureau of Weights and Measures (BIPM); for convenience, it retains its former acronym, CCQM (based on its former name, Consultative Committee on Quantity of Matter). By invitation Peter Rusch attended CCQM's workshop meeting on Redefinition of the Mole, held in Paris on April 9, 2014, as representative of ACS-NTS. Approximately 70 persons attended the half-day workshop in which eight speakers offered all points of view in current thinking about the redefinition issue. Highlights included a statement that the proposed definition of the mole has no impact on relative atomic masses, any uncertainty going into the molar mass constant, and a statement that the value of the dalton rather than the Planck constant should be fixed. A review of 18 chemistry textbooks revealed that none has a definition of the mole. During the discussion that followed, all points of view were aired and supported. No consensus was reached, and few participants were persuaded to change positions. All slides used by the workshop speakers are available at
http://www.bipm.org/ws/CCQM/MOLE/Restricted/welcome.jsp?ws=MOLE
(Username: MOLE; Password: RE-DEFINITION). A technical session, jointly sponsored by NTS and CCQM, may be organized for presentation jointly with the ACS meeting in Boston next year. The ACS Board of Directors has adopted a resolution inviting CCQM to co-locate its 2015 meeting with ACS's meeting in Boston.

Symposium on Redefinition of the Mole and Kilogram: Impact on Chemistry: David Ball, co-organizer with Censullo of the symposium cosponsored by NTS, ANYL, and IAC, reported that about 40 persons attended the symposium in which five international experts presented papers on the morning of August 11, 2014. Censullo presided and made introductory and concluding remarks. P. De Bièvre spoke about "Re-thinking the mole: Concerns and issues;" W. E. May about "The mole: Its history, definition, and realization;" P. J. Karol about "The new *SI* kilogram: *misère en pratique*;" H. Müller about "An Atomic Balance;" and C. J. Giunta about "Defining the mole and kilogram for chemical education."

IUPAC Names for New Elements: Giunta presented a written report pertaining to IUPAC's rule barring a previously proposed name or symbol for that of a new

element. A HIST full-day symposium on "The Lost Elements" presented at the San Francisco meeting and a forthcoming book focus on proposed elements that are not in the current periodic table. A note in a recent issue of *Chemistry International* pertaining to proposed *copernicium* can be accessed at http://degruyter.com/view/j/ci2014.36.4.26/ci2014.36.4.26.xml, and the link to the Oxford Press webpage about the book "The Lost Elements" is http://global.oup.com/academic/product/the-lost-elements-9780199383344.

"Periodic Table Live" Resource: Donivan Porterfield reported that a resource pertaining to the periodic table ("Periodic Table Live") is hosted on the Chemical Education Digital Library web site (www.chemeddl.org). He has inquired of ACS staff that maintains the resource about the correctness of portions of entries about some elements and has received expressions of interest in any suggestions for corrections for current content. He suggests that NTS consider promoting a systematic review of that content over some time. His report included several examples of current content about elements, including krypton, plutonium, and unnamed elements 114 and 116.

Biochemical and Carbohydrate Nomenclature: Derek Horton reported on recent actions of the IUPAC-IUBMB Joint Commission on Biochemical Nomenclature (JCBN). Major topics were enzymes, flavonoids, and carbohydrates. Ongoing work on the "Small Molecules Glossary" project focused on substrates and inhibitors of enzymes, radicals, and organometallic complexes. External review by IUPAC of the previously reported document "Flavonoid Nomenclature" has been completed and final corrections are being incorporated into it before publication. Revision of the 1996 IUPAC carbohydrate document is well underway, with attention to clarifications, symbolic representation of complex structures, and ways to bring bioinformatics specialists into a common understanding with the language of experimentalists. The "Glossary of Terms" in the 1996 edition has been very well-received and should be retained without change in the new edition.

The long and conscientious service of Horton as liaison between NTS and the biochemical and carbohydrate community was acknowledged and applauded by the meeting attendees.

UVCB Nomenclature: Michelle Rogers summarized some of the UVCB (substances of unknown or variable composition and biological materials). An ECHA (European Chemical Agency) regulation about substance names requires specific chemical names, which are to comply with IUPAC nomenclature, but IUPAC provides no guidance for naming UVCBs. So nomenclature is being set by ECHA without proper guidance, creating significant issues for the global chemical industry. An IUPAC project to develop IUPAC guidelines for UVCB nomenclature is needed.

NTS Subcommittee on Communication/Outreach: Robert Yokley, subcommittee chair, reported on the NTS PowerPoint presentations to other ACS units about NTS functions, responsibilities, activities, and expertise of potential use to those units. The PowerPoint presentation was prepared by Yokley, Michael Sheets, Censullo, and Fenske, and reviewed with suggestions for modification by Rusch and others. At the San Francisco meeting, Sheets made presentations to the Chemical Safety Committee and to two Divisions (Small Chemical Business and Nuclear Chemistry and Technology), Censullo to the Division of Inorganic Chemistry, and Rusch to the Division of Computers in Chemistry. On the basis of those experiences, Sheets suggested that future presenters take paper copies of the slides for distribution to the audience, and Censullo suggested that the venue for the presentation be checked for suitability in advance.

Yokley and Fenske have prepared an account of NTS information for inclusion in newsletters of the 32 Technical Divisions. Divisions and committees of the Society are being identified for possible liaison activities with NTS, and a letter of inquiry about interest in appointment of liaison(s) will be sent to them. NTS volunteers for these assignments will be needed. Porterfield volunteered to write a one-page summary on the Periodic Table for submission to *Journal of Chemical Education*, and other NTS members may assist with this activity. Volunteers are also requested for writing articles for other committees and Divisions that publish newsletter for their members.

NTS Subcommittee on Liaison: Donald MacLean, subcommittee chair, reported that an updated edition of the book "Reagent Chemicals", written by the ACS Chemical Analytical Reagent Committee, will have the new title, "Reagent Chemicals: Reagents and Standard Grade Reference Materials, ACS Specifications and Procedures." It will use the new atomic weights advocated by ACS and will be

used by users of methods supported by NIST and USP. A panel of experts is evaluating current pictograms (to guide language-impaired viewers) in the USP prescription drug information guidelines to determine their effectiveness and to recommend additions or revisions. For more information see http://www.usp.org/usp-healthcare-professionals/related-topics-resources/usp-pictograms. European Pharmacopeia, a sister organization to USP, has new editions of its publications/leaflets pertaining to nomenclature/identification, with particular focus on hazardous substances. See http://www.edqm.eu/en/EDQM-Downloads-527.html.

NTS Subcommittee on Long Range Planning: Tracy Williamson, co-chair of the subcommittee, suggested for consideration a survey by NTS of ACS member concerns about NTS activities.

DISCUSSION ABOUT IUPAC/NTS COMMUNICATIONS: Near the end of the meeting, an unscheduled discussion about communications between IUPAC and NTS ensued. Paul De Bièvre commented unfavorably on IUPAC's practice of largely restricting communications to national adhering organizations (NAS for the U.S., for example). Giunta commented on the modest concern about mole/kilogram issues among ACS members and its impact on NTS's possible input to international discussions about those issues. Rusch remarked that NTS (or ACS) needs to respond to questionnaire about attitudes toward mole/kilogram issues. He noted the absence of meaningful consultation from BIPM about matters affecting chemists and the practice of and education for chemistry. Kathryn Hughes, a member of the National Academy of Sciences and of the USNC to IUPAC, alerted NTS to a questionnaire generated by IUPAC to provide information for an IUPAC project to review the proposed redefinitions of the mole and kilogram. She requested NTS input to response to this questionnaire, based on the NTS role for nomenclature items within the ACS. The ensuing discussion produced consensus that NTS should respond to this appeal for input. Censullo suggested forming an ad hoc committee to prepare a draft response for review by the NTS membership. This committee agreed to prepare one within 10 days, to allow time for review by NTS in advance of the September 15 deadline requested by Hughes.

ADJOURNMENT: The meeting was adjourned at 4:42 p.m.

***Post-meeting addition*: Sad news:** G. Clark Dehne, a former chair of NTS and listed as a Friend of the Committee on the NTS roster, died in August at age 76 from cancer.

THE NEXT MEETING OF NTS WILL BE AN EXECUTIVE SESSION IN DENVER ON MONDAY, MARCH 23, 2015, 2:00-5:00 P.M.

Prepared by James G. Traynham, Secretary

ADMIN REPORTS

NTS Denver Council Report

As part of its continuing interest in the development of the International System of Units, known as the "new SI", NTS organized a half day symposium in San Francisco titled:" Redefinition of the Mole and Kilogram: Impact on Chemistry". The symposium, co-sponsored by the Analytical Chemistry Division and the International Activities Committee, featured five international experts, who addressed the scientific and pedagogical implications of the proposed redefinitions of the mole and kilogram.

At the San Francisco meeting, PowerPoint presentations were given to a number of ACS committees and divisions, explaining NTS expertise and capabilities. The NTS Communication/Outreach subcommittee undertook this task as a first step in identifying potential partners for collaboration.

In order to gauge the ACS membership's view of NTS, the Long Range Planning subcommittee, in concert with ACS staff, has produced a survey, which will be distributed to ACS members. Results from this survey will assist NTS in developing programs responsive to ACS membership needs.

Following a request from the United States National Committee (USNC), NTS prepared and delivered a response to an IUPAC questionnaire, intended to support a study of the proposed redefinition of the mole, and how chemists perceived the effects of these changes. The questionnaire sought opinions on the suitability of current and proposed definitions for the terms *mole* and *amount of substance.* In general, NTS responded as "not satisfied" with either the current or proposed definitions for mole and amount of substance.

A representative of NTS was invited to attend a workshop of the Consultative Committee on the Amount of Substance- Metrology in Chemistry and Biology (CCQM), held in Paris in April of 2014. As its name implies, this committee is responsible for the definition of the mole. It makes recommendations on this and other metrological items to the International Bureau of Weights and Measures (BIPM). Based on interactions with CCQM personnel at this meeting, plans were formulated for collaboration with CCQM at a future ACS National meeting. CCQM has made plans to hold a 2015 meeting in Boston, coincident with the ACS Fall meeting. The ACS Board of Directors has adopted a resolution welcoming CCQM to meet simultaneously with ACS in Boston in August of 2015. This will be the first such meeting of CCQM held in this country.

C&EN Short Report from San Francisco 2014 – ACS Committee on Nomenclature, Terminology, and Symbols

The ACS Committee on Nomenclature, Terminology, and Symbols (NTS) met in open meeting in San Francisco on Monday, August 11, 2014, with 32 attendees. A major report described the NTS-organized symposium, "Redefining the Mole and the Kilogram: Impact on Chemistry", a technical program session immediately preceding the NTS meeting. At that symposium, five speakers and approximately 45 attendees reviewed the pending redefinitions and explored the potential problems for practicing chemists and for chemical educators. It was noted that there has been little consultation with chemists about changes in definitions of the mole, amount of substance and the kilogram. To address this issue, NTS will provide input to the National Academy of Sciences, per their request, on how these new definitions might affect the chemical enterprise.

Other reports included systemization work on biochemical and carbohydrate nomenclature, committee communications and outreach to ACS Divisions on NTS activities and expertise, and United States Pharmacopoeia (USP) revisions to labeling and safety issues, and the inclusion of pictograms for language impaired users.

NTS continues its outreach to IUPAC and its adhering organization (National Academy of Sciences) with ongoing interactive communications.

American Chemical Society
Al Censullo, Chair
Gerald P. Fenske, Staff Liaison

American Chemical Society
2015 Committee Information Sheet

Committee	Committee on Nomenclature, Terminology and Symbols (NT&S)
Type	Other Committee of the Council Appointed by the President
Mission Statement	This committee examines problems and monitors developments in nomenclature, terminology, symbols and units, coordinates the activities of divisional and other committees dealing with such matters within the Society, advises and consults with editors of Society publications in matters related to nomenclature, terminology, and symbols, acts for the Council in the consideration and action on such documents and proposals presented to the Society, acts for the Council in providing liaison in matters of these issues with non-Society organizations, and makes recommendations to the Council in matters related to these issues.
Normal Meeting Schedule	Semiannually, at each national meeting. Generally holds an executive meeting of the full committee on Monday afternoon at the Spring meeting and an open meeting on Monday afternoon of the Fall meeting, 2:00 pm to 5:00 pm.
Reimbursement Policy	No reimbursement is provided for the open meeting. Members receive reimbursement to attend the executive meeting. Associate members and Consultants do not receive reimbursement from NTS. For meetings, held at the national meeting, the Councilors Travel Expense Program provides funds for members, associates and consultants who are Councilors.
Staff Liaison	Gerald Fenske, Chemical Abstracts Service Tele: 614-447-3600, ext. 3102 E-mail: gfenske@cas.org Fax: 614-447-3713
Committee on Committees Liaison	Janet L. Bryant

3/2/2015

Expense Reimbursement
ACS Committee on Nomenclature, Terminology and Symbols
ACS National Meetings

1. For committee members participating at the executive meeting (ACS Spring national meeting) who need support, expenses are reimbursed as follows:

   - Airfare - coach fare
   - Hotel - ACS rate up to 2 days
   - Meals - up to $75.00 each day with two day limit
   - Airport parking/airport mileage - up to three days parking; mileage rate for reimbursement will be based on IRS Standard Mileage Rate (currently 0.575 cents per mile)
   - Shuttle or taxi fare - from/to airport/hotel
   - Tips - reasonable and customary for out of pocket tipping such as luggage transport, hotel employee services

2. Please keep all detailed receipts for qualified expenses and submit them with the committee expense report.

3. No alcohol expense is reimbursable.

4. If an expense category does not appear above; then it is not eligible for reimbursement.

5. Committee associates and consultants members do not receive expense reimbursement.

6. For those committee members who also serve as councilors or work with other ACS committees where expenses are reimbursed, please continue to apportion expenses to each committee activity respectively.

7. Please submit your signed expense form with detailed receipts within 30 days of meeting to:

   Gerald P. Fenske, Staff Liaison
   ACS Committee on Nomenclature, Symbols & Terminology
   c/o Chemical Abstracts Service
   2540 Olentangy River Road
   P. O. Box 3012
   Columbus OH 43210-0012

If you have any questions, please contact Jerry Fenske at (614) 447-3600 ext. 3102 or gfenske@cas.org.

Travel Vouchers

- A change to the ACS Washington Accounts Payable Policy for expense reimbursements has been approved by the ACS Executive Leadership Team and is effective immediately. Specifically, Policy 4.60 (Travel Related Expenses) is updated as follows:

The Travel Expense Voucher should include charges for travel made on a personal credit card, or expenses paid out of pocket by the traveler. Trip reports should be submitted within 10 business days after completion of the trip. Any expenses paid on a personal credit card or out-of-pocket MUST be submitted within 60 days of the trip/incurrence or they will not be reimbursed. Any exceptions must be submitted to and approved by the Director of Finance & ACS Controller.

- This change will ensure timely processing of expenses so that costs are recognized in the proper accounting period and fully considered during appropriate budget cycles.

SUBCOMMITTEE REPORTS

2015 NTS Subcommittees

Long Range Planning

Co-Chairs: Tracy Williamson & Michael Mosher

Mark Benvenuto
Jeff Rahn
Jack Secrist
Michael Sheets

Communication/Outreach

Chair: Robert Yokley

Ben Chastain
David Dillon
Richard Hermens
Donivan Porterfield
Wayne Wolsey

Education

Chair: Paul Karol

David Ball
Carmen Giunta
Bob Howell
Graham Peaslee
Daniel Rabinovich
James Traynham

Liaison

Chair: Donald Maclean

Derek Horton
Gail Karet
Warren Powell
Michelle Rogers
Jeff Wilson

Committee Structure

The Committee on Nomenclature, Terminology, and Symbols presently has four standing subcommittees. Associate as well as full members are welcome to serve on subcommittees. All committee members serve on at least one subcommittee. Goals and responsibilities for the subcommittees are intended to cover the range of topics likely to be encountered. Special projects may involve the formation of a task force, which would remain in place until the end of such project.

Goals/responsibilities for Subcommittees

Long range Planning
*develop and prioritize current NTS projects
*explore and evaluate potential future issues of interest to NTS and ACS

Communication/outreach
*increase awareness of NTS expertise to other ACS units
*foster and facilitate participation with other ACS units on items of common interest

Education
*address nomenclature (symbols, terminology, and units) -related items of pedagogical interest
*develop materials suitable for explaining current nomenclature issues
*draw attention to pending discussions of current NTS issues

Liaison
*continue existing liaisons with units outside of ACS
*develop new significant relationships with outside organizations

Communication/Outreach Sub-Committee Report
NTS Committee - 11 August 2014 - San Francisco
Robert A. Yokley

The Communication/Outreach Sub-Committee members include Ben Chastain, Richard Hermens, Gail Karet, Don Porterfield, Wayne Wolsey, and Robert A. Yokley.

NTS Power Point Presentation at Division and Committee Meetings in San Francisco

(1) Various ACS Divisions (28) and Committees (12) were identified as potential candidates for an NTS PowerPoint presentation. A letter prepared by Robert Yokley, Al Censullo, and Jerry Fenske was sent to the chairs of these 40 ACS Committees and Divisions to inquire if a presentation from NTS was desirable. On committee and four divisions responded positively and one committee requested a presentation in Denver in March 2015. One committee requested material to be included in their agenda books.
(2) A PowerPoint presentation was prepared by Robert Yokley, Mike Sheets, Al Censullo, and Jerry Fenske in which the functions, responsibilities, and activities of the NTS Committee are described. Peter Rusch and others reviewed, commented, and made recommendations.
(3) The NTS slides were presented by Mike Sheets on Sunday (August 10) to the Chemical Safety Committee and the Small Chemical Business and the Nuclear Chemistry and Technology Divisions. Al Censullo presented the slides to the Division of Inorganic Chemistry and Peter Rusch presented the slides to the Computers in Chemistry Division on Monday (August 11).

Material for inclusion in 32 technical division newsletters

(1) NTS materials were written and prepared by Robert and Jerry for inclusion in the 32 Technical Division newsletters.

NTS Committee Liaison to Other ACS Divisions and Committees

(1) Various ACS Divisions (22) and Committees (10) were identified as potential liaison candidates with NTS. This number is too large and will require further reduction (this is a near future project that can be conducted via e-mail).
(2) A letter will be sent to the chairs of the selected divisions and committees to inquire if appointing a liaison between them and NTS is mutually beneficial (Robert will write first draft of the letter and send to Al and Jerry).
(3) We will need volunteers from NTS to serve as liaison to those divisions and/or committees that share interest in a liaison with NTS.

One Page Summary of Periodic Table

(1) Don Porterfield volunteered to write a one page summary article on the Periodic table for the Journal of Chemical Education. We need other committee members to assist with this effort.

Articles for Newletters

(1) We need volunteers to write articles for submission to other divisions and committees that publish newsletters for their members. Some examples include the Senior Chemists Committee, YYC, Council, and the Nuclear Chemistry and Technology Division.

Albert Censullo, Ph.D.
Chair, Committee on Nomenclature, Terminology, and Symbols (NTS)
March XX, 2015

Dear (Name of Div or Comm addressed in this letter),

The Committee on NTS wishes to determine if there are any mutually beneficial projects or programs that warrant the creation of a liaison between (name of Div or Comm) and NTS. We request that you respond to Al Censullo (acensull@calpoly.edu or 805.541.0636) by March XX, 2015.

According to its charter, the Committee on NTS examines problems and monitors developments in nomenclature, terminology, symbols, and units, coordinates the activities of divisional and other committees dealing with such matters within the Society, advises and consults with editors of Society publications, acts for the Council in the consideration and action on such documents and proposals presented to the Society, acts for the Council in providing liaison in matters of these issues with non-Society organizations, and makes recommendations to the Council in matters related to these issues.

NTS committee membership consists of experts in various fields of nomenclature, terminology, symbols, and units as well as individuals active at all academic education levels. Through joint membership with national and international terminology committees, NTS provides leadership, cooperation, support, and guidance for ACS membership and publications (including C&EN).

The Committee on NTS wishes to thank you for taking your valuable time to consider the potential advantages of a closer working relationship between our committees (or between our committee and your division). Please contact us any time you desire additional information.

Best wishes,

Al Censullo
Chair, Committee on NTS

NTS Subcommittee on Education:

Proposed project: Column in the Journal of Chemical Education

Paul J. Karol, Chair of the Subcommittee is awaiting a reply from the Editor of the Journal of Chemical Education to our proposal of a frequent short contributions addressing interesting/important topics in nomenclature, terminology, symbols and units. No themes were specified and no examples were given. Possible themes (more to be solicited from Subcommittee members) include:

>> D- and L- vs d- and l-
>> The four Laws of Terminology (promotional) The shortage of pure
>> oxidane/hydroxylic acid What is InChi?

For Liaison Subcommittee:

Chairperson selection and plans for future

From: Williamson, Tracy [mailto:Williamson.Tracy@epa.gov]
Sent: Wednesday, March 04, 2015 1:43 PM
To: Albert C Censullo; Fenske, Gerald Jr.; Robert A. Yokley; Dr. Michael Mosher; Rahn, Jeffrey; Mark A Benvenuto; Dr. Michael Sheets; Secrist, Jack; donald.maclean@bayer.com; pk03@andrew.cmu.edu
Subject: FW: NTS Survey Results attached

Colleagues,

Please see attached report from our survey. The survey was sent to more than 2,400 ACS members, and 125 responded (5%). I think (first glance) there is some very useful feedback in the report – there's certainly enough to discuss/digest for now.

When we first talked to ACS about doing this, they indicated that surveys *can* be sent out to "the Society," however, this apparently is not done typically. ACS has sample subsets of members that they use for most surveys. These sample subsets seem to be pretty carefully constructed to be as representative of the Society as possible. ACS sent the survey out several weeks ago to one sample subset (of about 1200), then at our request, sent it out to a second sample subset. The attached is the compiled results. ACS noted little change between the two subsets of results. We can always follow up with a more targeted survey in the future after we have considered the feedback from this first attempt.

Tracy

From: Alicia P. Filson [mailto:a_filson@acs.org]
Sent: Tuesday, March 03, 2015 3:10 PM
To: Williamson, Tracy
Subject: RE: NTS Survey Questions

Tracy,

We sent the survey to another sample of members and revised the report (attached). We didn't see much change from the first group, which is good!

Let me know if you have questions.
Alicia

Alicia Filson
Research Associate | Research & Market Insights
1155 16th St., NW | Washington, DC 20036 | O-1228
a_filson@acs.org | (t) 202.872.4601 | (f) 202.872.6337

ACS Chemistry for Life
American Chemical Society

Nomenclature, Terminology, and Symbols Committee (NTS)

The ACS Committee on Nomenclature, Terminology, and Symbols (NTS) recently initiated a long-range planning effort in order to identify major initiatives to be taken during the next three-to-five years. In February of 2015, a survey was conducted with a random selection of ACS members to gauge importance of particular initiatives and interest in upcoming symposium topics. The survey was sent to more than 2,400 ACS members, 5% completed the survey (n=125).

KEY FINDINGS

- More than half of respondents were not at all familiar with the Nomenclature, Terminology, and Symbols Committee (59%); another third were familiar by name only (32%).
- At least three-quarters of respondents thought the main goals of the NTS Committee were important; particularly working with other organizations involved in similar topics (86%).
- Most respondents said it was important to have active involvement in decisions and standards related to the chemical usage of N.T.S.U. over the next three-to-five years (83%).
    - By contrast, less than half of respondents said it was important for the Committee to sponsor symposia on topics or concepts related to the chemical usage N.T.S.U. (44%). These findings were validated as few respondents indicated they would be likely to attend symposia in the next three-to-five years (19%).
- More than half of respondents would prefer getting news about N.T.S.U through the ACS Matters Newsletter (57%).

ANNOTATED QUESTIONNAIRE

The NTS committee acts on behalf of Council in matters relating to the chemical usage of nomenclature, terminology, symbols, and units, coordinates the activities within the Society, consults and advises editors of publications (including C&EN), initiates, reviews, and recommends adoption of documents and proposals (as appropriate), liaises with other national and international organizations, committees, and commissions similarly involved, and provides a means for members of the SOCIETY to participate in the consideration of these matters.

Q1. Before receiving this communication, how familiar were you with the ACS Committee on Nomenclature, Terminology, and Symbols (NTS)?

(n=162)	Count	Percent
Very familiar	3	2%
Somewhat familiar	11	7%
Familiar by name only	52	32%
Not at all familiar	96	59%

Q2. Thinking about ACS's role with nomenclature, terminology, and/or symbols, how important is it for the ACS to ...

	Count	Extremely important	Very important	Somewhat important	Not very important	Not at all important
Study problems relating to the chemical usage of nomenclature, terminology, symbols, and units	135	31%	49%	16%	4%	--
Act on behalf of the ACS in matters relating to the chemical usage of nomenclature, terminology, symbols, and units	134	30%	49%	20%	1%	--
Provide ACS members the opportunity to participate in the consideration of nomenclature, terminology, symbols, and unit matters	135	22%	54%	20%	4%	--
Advise editors of publications relating to the chemical usage of nomenclature, terminology, symbols, and units	135	35%	49%	15%	1%	--
Work with other organizations involved with nomenclature, terminology, symbols, and units	135	40%	46%	12%	2%	--

Q3. How important is it for the ACS Committee on Nomenclature, Terminology, and Symbols to focus on each of the following initiatives in the next three to five years?

	Count	Extremely important	Very important	Somewhat important	Not very important	Not at all important
Sponsor symposia on topics or concepts related to the chemical usage of nomenclature, terminology, symbols, and units	126	11%	33%	47%	7%	2%
Active involvement in decisions and standards related to the chemical usage of nomenclature, terminology, symbols, and units	126	32%	51%	15%	2%	1%
Increase international visibility of ACS in matters concerned with nomenclature	124	19%	46%	27%	6%	2%
Participate in community/public outreach on topics related to nomenclature, terminology, symbols, and units	126	13%	47%	29%	9%	2%
Prepare documents to explain new SI definitions to the public	126	34%	43%	15%	6%	2%

Q4. Please elaborate on the importance of the initiatives above, and/or describe other initiatives or activities that the ACS Committee on Nomenclature, Terminology, and Symbols should focus on in the next three to five years? Please be specific.

- "ACS has an opportunity of being the worldwide leader in this topic and increase the uniformity in this area. This will bring savings (time, money, effort) for everyone involved in chemistry: industry, academia, government, etc"
- "ACS should be driving the discussions about Nomenclature and Chemical symbols. If improper usage is found, an alternative term should be offered and adopted."
- "Advise old-timers to include new terminologies, at least in parenthesis, in their books and publications. In any transition, it's helpful to have a mixed-period where old and new conventions are represented."
- "Anything that the ACS can do to help counteract the misuse of chemical nomenclature and chemistry matters in the media is vitally needed. Too many in the public have little to no understanding of chemistry and chemical terms."
- "As chemistry evolves it also will increase the distance between chemist/researcher and the general public. This distance will create misconceptions, mislabeling, and potential public safety issues. Take for instance the term "nano" and the extensive debate between what is happening with the EPA versus FDA and industrial safety. It is important for the chemical community to approve and accurately define NTS not just for research purposes, but also government agencies and the general public."

- "Educate the general public re chemicals."
- "Encourage all in the chemical industry - manufacturers, suppliers, etc. - to use the proper names rather than common names for chemicals -particularly inorganic ones. Let's try to eliminate calling it cupric sulfate."
- "Given the popular attitude to science in general, explaining SI definitions etc. does not seem to be a useful way to pass the time. It is far more important to try to change the general understanding and appreciation of science by the layman with the hope that this will eventually change the implementation of sound scientific policy."
- "I have one pet peeve about nomenclature in simple cycloalkanes where there are multiple substituents, but only at two sites in the ring. It has always seemed to me that the E/Z nomenclature should be applicable to small-to-medium-sized rings, but instead there is the most unwieldy r-n-cis etc system. Can you please initiate something at the IUPAC affiliate level?"
- "I have to admit I am confused since I thought IUPAC determined what we did on these issues....."
- "I think that the NTS should focus on making sure that the correct SI units appear in all publications related to the ACS...that includes C&EN. I also think that a standardization across broad fields should be pursued to ensure that many industries can begin using the same units; for example viscosity is given in different units depending on the industry, which makes comparisons across industries difficult."
- "I think the ratings are self-explanatory. The general public needs some info on SI units but has little use for nomenclature."
- "Informing the non-ACS/nonscientific public about this is very important."
- "It is important that we speak the same chemical language so that there is no confusion as to what a given term means."
- "Let researchers know its importance first."
- "Mass is in the process of a new definition, ACS should be involved."
- "New research findings that lead to changes in the nomenclature or the units used should be of utmost importance to all members. Especially those who take classes in two or more languages where the terminology can sometimes be a bit tricky to understand at first.
- "Outreach focused on pulling interest toward this part of science is very important. It is important for ACS to create interesting ways to show people why nomenclature, terminology and symbols is important and how to get involved. Outreach aimed at young scientists (college age especially), should be focused on because it could lead to more students moving toward a career in this type of science."
- "Public education"
- "Start using SI units since elementary school"
- "The ability for clear concise communication of chemical needs and/or discussions can make the difference between success or failure of a project."
- "There is a similar committee of IUPAC; working in close collaboration with it is important"
- "Web and App related implementations of NTS"
- "Work towards open standards for terminologies and nomenclature that cut across disciplinary boundaries. Adopt existing generalized technologies/methods wherever possible to ensure that ACS efforts integrate with other ongoing efforts in the field. Most importantly, look outwardly, beyond the field of chemistry to ensure that committee efforts are neither insular or ignored by other fields. Names, terms, concepts are fundamental to all human communication."

Q5. When the ACS contacts you, how would you like to be informed about topics and activities related to nomenclature, terminology, symbols, and units, if at all? Select all that apply.

(n=126)	Count	Percent
ACS Matters Newsletter	72	57%
ACS NTS Website	34	27%
Facebook	10	8%
Twitter	4	3%
Journal or publication news	46	37%
Society Reports about NTS	20	16%
Other, please specify:	12	10%
I do not wish to be informed about this	16	13%

Other responses include:

- C&EN (n=7)
- Email (n=6)

Q6. How likely are you to attend symposia related to nomenclature, terminology, symbols, and units at an ACS meeting in the next three to five years?

(n=122)	Count	Percent
Definitely would	4	3%
Probably would	19	16%
Might or might not	30	25%
Probably would not	51	42%
Definitely would not	18	15%

Q7. What, if any, topics or concepts would you be interested in attending? Please be specific.

- "A heterocyclic nomenclature system adoption. Supramolecular system?"
- "Automated naming software"
- "Environmental Chemistry"
- "geometric isomers in cycloalkanes"
- "Helping the public better understand the uses of chemistry and why the term "chemicals" is not a "bad" word."
- History of nomenclature and how it has affected the scientific world would be very interesting. I would also love to know how it plays into science policy or if it is important in policy."
- "Move towards increasing transparency of trade, original derivative based, and new (IUPAC etc.) naming symbols etc. With the vast computer resources it should be possible to "translate" all names of any one compound - seamlessly - and link to structure info, trade info etc. BOOLEAN SEARCH is LAME in the extreme. ACS can make its biggest contribution by going beyond BOOLEAN SEARCH."
- "My difficulty is my location, not a matter of interest. I am on Guam."
- "Nanomaterials, polymeric materials"
- "Nomenclature"

- "Organic Chemistry, Physics"
- "Polymer related nomenclature."
- "Process development, Process safety"
- "Radiation technology, solar power, polymeric materials."
- "Semantic/syntactic interface between life sciences and chemistry."
- "Topics of interest would be "Nano" in relation to inorganic materials and soft matter (for instance, is a micelle or liposome a nano material and should they be regulated like an inorganic nano particle); safety symbols, labeling, and numbers; impact of catch phrases or acronyms (smart materials,etc.)"
- "Viscosity units across industries and other unit topics that are cross industry but values given in different units depending on the industry."

Q8. Which, if any, ACS Committees are you currently a member or associate? Select all that apply.

(n=125)	Count		Count
Analytical Reagents	1	Local Section Activities	9
Board of Trustees, Group Insurance Plans for ACS Members	--	Meetings & Expositions	1
Budget and Finance	1	Membership Affairs	1
Chemical Abstracts Service	--	Minority Affairs	--
Chemical Safety	2	National Historic Chemical Landmarks	--
Chemistry and Public Affairs	1	Nomenclature, Terminology and Symbols	--
Chemists with Disabilities	--	Nominations & Elections	--
Clinical Chemistry	--	Patents and Related Matters	--
Community Activities	--	Petroleum Research Fund Advisory Board	--
Committees	1	Professional and Member Relations	--
Council Policy	--	Professional Training	--
Constitution and Bylaws	--	Project SEED	--
Corporation Associates	--	Publications	3
Divisional Activities	--	Public Affairs and Public Relations	--
Economic and Professional Affairs	--	Public Relations and Communications	--
Education	3	Senior Chemists	2
Environmental Improvement	2	Science	1
Ethics	--	Society Committee on Education	--
Governing Board for Publishing	--	Technician Affairs	--
Grants and Awards	--	Women Chemists	1
International Activities	2	Younger Chemists	2

Q9. Which, if any, ACS Technical Divisions are you currently a member? Select all that apply.

(n=125)	Count		Count
Agricultural & Food	3	Energy and Fuels	2
Agrochemicals	5	Environmental Chemistry	9
Analytical Chemistry	8	Fluorine Chemistry	1
Biochemical Technology	2	Geochemistry	1
Biological Chemistry	3	History of Chemistry	1
Business Dev. & Mgmt.	--	Industrial & Engineering Chemistry	3
Carbohydrate Chemistry	1	Inorganic Chemistry	14
Catalysis Science & Technology	2	Medicinal Chemistry	8
Cellulose & Renewable Materials	1	Nuclear Chemistry & Technology	1
Chemical Education	12	Organic Chemistry	20
Chemical Health & Safety	2	Physical Chemistry	14
Chemical Information	1	Polymer Chemistry	4
Chemical Toxicology	--	Polymeric Materials: Science & Eng	3
Chemistry & The Law	--	Professional Relations	1
Colloid and Surface Chemistry	1	Rubber	--
Computers in Chemistry	6	Small Chemical Businesses	1

Q10. Please indicate your current primary employment status.

(n=125)	Count	Percent
Employed full time	85	68%
Employed part time	8	6%
Postdoctoral or other fellowship	--	--
Graduate Student	11	9%
Undergraduate Student	5	4%
Not employed but actively seeking employment	5	4%
Not employed and not seeking employment	1	1%
Fully retired	10	8%

Q11. In what sector is your current or most recent primary employment? If you have never been employed but are seeking a job, please select the industry in which you are seeking employment.

(n=122)	Count	Percent
Industry, manufacturing	23	19%
Industry, non-manufacturing	17	14%
Academia	64	53%
Government	14	11%
Self-Employed	4	3%

Q12. What is your current or most recent work specialty? If you have never been employed but are seeking a job, please select the specialty in which you are seeking employment.

(n=123)	Count	Percent
Agricultural/food chemistry	6	5%
Analytical chemistry	6	5%
Biochemistry	3	2%
Biotechnology	3	2%
Chemical education	6	5%
Chemical engineering	7	6%
Clinical chemistry	1	1%
Environmental chemistry	8	7%
General chemistry	2	2%
Inorganic chemistry	9	7%
Materials science	9	7%
Medicinal/pharmaceutical chemistry	8	7%
Nanochemistry	2	2%
Organic chemistry	19	15%
Physical chemistry	10	8%
Polymer chemistry	3	2%
Other chemical science, please specify:	6	5%
Business administration	--	--
Computer science	--	--
Education	6	5%
Law	1	1%
Medicine/healthcare	2	2%
Other non-chemistry, please specify:	6	5%

Other chemical science:
- Water Quality/Water Treatment (n=2)
- Coatings
- Metallurgy
- Natural Products
- Radiochemistry

Other non-chemistry:
- Clinical Sciences
- Engineering
- Forensic Science
- Grants administration
- Pharmacy
- SIS Engineering

Q13. What is your gender?

(n=123)	Count	Percent
Male	92	75%
Female	31	25%

Q14. What is your age?

Open-end responses were recoded into categories.

(n=118)	Count	Percent
Less than 20 years	--	--
20-29	20	17%
30-39	19	16%
40-49	12	10%
50-59	31	26%
60-69	27	23%
70-79	9	8%
80+ years	--	--

Q15. If you have any other comments or suggestions for the ACS Committee on Nomenclature, Terminology, and Symbols, please provide them below.

- "An abbreviation for "molecule" would be wonderful. It makes no sense that "mole" has an abbreviation, while molecule does not."
- "Best wishes in your endeavor."
- "Do not act by ACS alone, I wish ACS go together with other chemical societies."
- "I think the committee should work more on spreading information about its existence and what its role is in the scientific community."
- "Important but dull - spice it up!"

From: Secrist, Jack [mailto:jsecrist@southernresearch.org]
Sent: Thursday, March 05, 2015 4:11 PM
To: Mosher, Michael; Williamson, Tracy; Albert C Censullo; Fenske, Gerald Jr.; Robert A. Yokley; Rahn, Jeffrey; Mark A Benvenuto; Dr. Michael Sheets; donald.maclean@bayer.com; pk03@andrew.cmu.edu
Subject: RE: NTS - Long Range Subcommittee Meeting

Since I am not going to be in attendance at the meeting, I offer my comments below:

- First, after reading through the answers and considering the goal, I believe that the cross-section of chemists who responded do provide meaningful data for us to utilize going forward. Though it was only 5%, the responses were thoughtful and appropriate.
- Clearly, symposia on NTS topics are not exciting to most chemists, and we have seen that over the years. To me, it suggests that we should not seriously consider pushing for a symposium unless the topic is clearly exciting and new and critical to the chemical enterprise. Such topics are certainly rare. We can better focus our efforts in other directions, many of which are suggested in the responses or have already been suggested by committee members.
- It is clear that the efforts of the committee are considered important to the chemical enterprise in general and to ACS specifically. At the same time, the NTS areas, while critical to chemists, and important to monitor and get right, are not particularly exciting and most chemists are content to let the committee keep an eye on things and update at relevant times. The ACS Matters Newsletter should suffice for almost everything. Something of broad and heightened interest could be communicated with a different vehicle.
- There was significant comment on communication with a broad audience, and the importance of that communication as we go forward. I believe that the committee should continue to look for ways to make a difference in communicating chemistry to the general public as well as to the scientifically more knowledgeable non-chemists in the country and around the world. Truly, we regularly see editorials and commentary exhorting scientists to commit time and effort to this type of communication, and the NTS committee can certainly move in that direction.
- To summarize, we need to accept the fact that NTS is just not very exciting but is very important, and select our directions and approaches in light of that fact.

Division of Carbohydrate Chemistry, American Chemical Society,

and ACS Committee on Nomenclature, Terminology, and Symbols

249th National ACS Meeting
Denver, Colorado, March 2015

Report on Biochemical and Carbohydrate Nomenclature

This report is a brief update on the detailed report presented at the Dallas ACS meeting in March 2014 to the ACS Committee on Nomenclature, Terminology, and Symbols, and to the ACS Division of Carbohydrate Chemistry. It concerns primarily the discussions and actions taken at the meeting in Utrecht, The Netherlands, of the Joint Commission on Biochemical Nomenclature (JCBN) during May 12—14, 2014.

Attending the meeting were Gerard Moss (Chairman); Richard Cammack; Kristian Axelsen; Ron Caspi (Secretary); Derek Horton; Masaaki Kotera; Andrew McDonald; Ida Schomburg; Keith Tipton; Hans Vliegenthart (host for the meeting); Shuchismita Dutta; and Observers, IUPAC Division VIII; Ture Damhus; Karl-Heinz Hellwich; Marcus Ennis; Sameer Velankar; and Dietmar Schomburg.

Major topics were enzymes, flavonoids, and carbohydrates. The previous report detailed the ongoing work on *Enzyme Nomenclature and Classification*, and an additional 300 entries into the EC List were reported. Ongoing work on the *Small Molecules Glossary* project focused on substrates and inhibitors of enzymes, free radicals, and on organometallic complexes. The new Blue Book, on Nomenclature of Organic Chemistry, has now appeared. The IUPAC-IUBMB document on *Flavonoid Nomenclature,* previously reported to this committee, was developed by a panel including Amelia Rauter, Derek Horton, Gerard Moss, Bernardo Herold, Karl-Heinz Hellwich, Ida Schomburg, and Marcus Ennis. The document has completed its external review by IUPAC and the final corrections are being incorporated into the document prior to its publication.

Carbohydrate Nomenclature

The expert panel charged with revising the 1996 IUPAC carbohydrate document devoted a long session in Utrecht in making a point-by-point review of the 1996 document (2-Carb) with the view to covering new areas that have arisen, providing new examples, clarifying some of the wording in 2-Carb, discussing symbolic representation of complex structures, and seeking ways to bringing the bioinformatics specialists into a common understanding with the language of the experimentalist.

The carbohydrate panel included the following: J. F.G.Vliegenthart, Derek Horton, Amelia Rauter, G.P.Moss, Karl-Heinz Hellwich, Thomas Luetteke, Martin Frank. Sandro Sonnino and Nuno Xavier,) earlier appointed to the panel, were absent.

The panel set out to revise each of the 39 sections in 2-Carb with the target objective of a revised document, identified as 3-Carb. Within the time available, all of the sections through 2-Carb-32 had been discussed and revised, and a record of the revisions noted. Considerable work remains to be done on the sections 2-Carb-32 through 2-Carb-39, and this will be undertaken at the time of the next meeting of the panel, now scheduled for May 11—13, 2015 in Braunschweig, Germany. Some of the items in 2-Carb for detailed discussion and revision are noted here:

2-Carb-36.4 **Trivial names.** This list of trivial names and their systematic equivalents needs to be expanded to more examples.

2-Carb-37 **Cyclic oligosaccharides.** This section requires significant alteration to reflect current usage. The cyclodextrin trivial names should be retained, but the systematic names using the "malto" infix should be revised, as there are many different linkage-modes known. The "cyclohexakis" and "cycloheptakis" prefixes can be used with the monosaccharide components in any linkage-mode. The literature reports cyclic that have been termed "cyclofructins". Such names should conform to the accepted "an" suffix for new carbohydrates, and not perpetuate a suffix used for proteins.

2-Carb-38 **Symbolic depiction of oligosaccharide structures.** The extended form 2-Carb-38.3 should be retained as the definitive form, but the "condensed" form 2-Carb-38.4 should be removed, while the "short" form 2-Carb-38.5 should be retained for use when the ring size and enantiomeric identity of the monosaccharides are independently defined. The "short" form provides a direct connection to the iconic presentation recommended by the Consortium for Functional Glycomics (see examples to be presented) and which is recommended for adoption in 3-Carb.

2-Carb-39. **Polysaccharides.** This section requires significant expansion to incorporate many more examples of commercially important polysaccharides, as well as acceptable ways to name synthetic modification of such natural polysaccharides.

2-Carb-39.9 **Glycoproteins, glycopeptides, and peptidoglycans**. These need a full section on their own, with major augmentation and depiction along the lines of the N-glyco-tetrapeptide example supplied, displaying a glycopeptide of 25 monosaccharides attached to a tetrapeptide, with the oligosaccharide displayed both as a full conformational formula and in the iconic system noted in 2-Carb-38. The two examples of neoglycoproteins need major supplementation to illustrate new linkers between the carbohydrate and protein, notably the triazole linker.

In the **Appendix**, the lists of trivial names need to be augmented. The **Glossary of Terms** in 2-Carb has been very well received and should be retained, as is, in 3-Carb.

Submitted by Derek Horton.

IUPAC Division of Chemical Nomenclature and Structural Representation (Division VIII)

Report for the ACS Committee on Nomenclature Terminology, and Symbols (March 9, 2015)

The Division Committee of the IUPAC Division of Chemical Nomenclature and Structural Representation (Division VIII) met in Bangor, UK (Wales) on August 3-4, 2014. The Division's President (Karl-Heinz Hellwich) reported that NAO's (National Adhering Organizations) do not get sufficient information about IUPAC activities through the Secretariat. The NAO for the United States is the National Academy of Sciences through its US National Committee for IUPAC and not ACS. This arrangement has always seemed strange. So, how does the NAS communicate with IUPAC. In the distant past the NAS had nomenclature committees that paralleled the ACS Divisional Committees. And so did IUPAC. As the NAS nomenclature committees evolved, their membership became basically the same as the ACS nomenclature committees and simply faded away. And, IUPAC nomenclature activities are now merged into one IUPAC Division while other disciplinary activities of the individual IUPAC Divisions remained with the original IUPAC Divisions. Interaction between IUPAC nomenclature activities and the disciplinary divisions is maintained by liaison between them and Division VIII. For example, Dan Rabinovich is the liaison for Division II with Division VII and Alan Hutton for Division VIII with Division II. Similarly, Amélia Rauter with Division III, Phil Hodge and/or Karl-Heinz Hellwich with Division IV and Andrey Yerin with Division I. The question about how does information about IUPAC activities get to the US NAO.

Last March, I finally was able to announce the publication of *Nomenclature of Organic Chemistry, IUPAC Recommendations and Preferred Names* 2013, the new edition of the Blue Book, a project that took over twenty years to complete. However, today I must report that it is not yet complete. Unfortunately, some 900 'errors' have been reported a considerable number of which should have been discovered by adequate proofreading before publication. Other 'errors' were found by translators. Many of these reported 'errors' can be considered as quite minor such as spaces before or after a hyphen in a name, italic commas, misaligned locants, etc. In addition some are cosmetic corrections, such as an extra space in text, a missing and non-meaningful closing parenthesis, doubled words in the text, etc. A number of reported 'errors' are errors of omission or perceived clarity by individuals. A few questions concerning content were brought out that will need further study and codification. After Henri Favre's death, I was left with the total responsibility for the final publication of this mammoth work and unfortunately pressure from IUPAC administration (the project was scheduled for completion in 2003) and the publishers were pushing hard for a 2013 publication (we made it in December), and the shear amount of effort that was still needed was clearly insufficient. Also, Henri had the major responsibility for Chapter 9: Specification of Configuration and Conformation and Chapter 10: Parent Structures for Natural Products and Related Compounds; my help in these two areas was always minimal. Simply put, there were just not enough eyes looking at the manuscript before submitting the manuscript for publication. One person was recruited to 'edit' the manuscript, but only two months were allowed for this effort. The index which was done by contract by the published is clearly insufficient. It must be completely redone.

One very serious error was discovered. Section P-45 deals with the selection of the preferred IUPAC name. Preferred IUPAC names for many of the examples illustrating a very late rule in this selection process based on alphanumeric order, P-45.5.1, should have been determined by a

previous hierarchical rule dealing with lower locants for substituents when compared in the order that they appear in the name, and would have to be moved from P-45.5.1 to P-452.3.

The plan forward is to publish a list of actual errors that affect names or structures as soon as possible while maintaining a separate list of non-nomenclatural, cosmetic, printing, or minor typographical errors that would not be published. Both of these files would eventually be incorporated into a full pdf republication of the entire Book.

Division VIII is involved in many projects which are in various stages of progress. They can only be listed here with brief comments.

(1) Nomenclature of cyclic peptides (2004-024-1-800). No report on further progress with this project which started in 2004.

(2) A comparison of the assignment of hydro prefixes, added hydrogen, and indicated hydrogen as developed by IUPAC, CAS, and Beilstein (2012-037-1-800). This project developed from initial work begun in CNOC.

(3) Preferred names for inorganic compounds (2012-039-2-800). A document on extension of the kappa method for specifying ligand attachments to central atoms, has become more intricate but should be ready for approval status. A document for selection of central atoms for preferred names of coordination complexes is progressing. And a list of nonsystematic names to be retaining is being compiled. A whole new way of naming ligands has been proposed by WHP.

(4) Essentials of Organic and Inorganic Nomenclature (2010-055-1-800). The document "Brief Guide to the Nomenclature of Inorganic Chemistry" was accepted by PAC and will be published soon. The accepted copyedited version was not based on the revised version that was submitted after review. This report contains no new recommendations. The organic document is still a work in progress.

(5) Nomenclature for polyhedral boranes and related compounds (2012-045-1-800). This project is a continuation of several earlier projects on boron nomenclature and involves consideration of a combination of organic substitution principles and inorganic additive principles for solving problems in naming adducts and ions.

(6) Nomenclature for metallacycles containing transition metals (2013-030-1-800). This project is almost ready for the approval process and also includes consideration of combining organic substitutive principles and inorganic additive principles.

(7) Nomenclature of flavanoids (2009-018-2-800). Publication of recommendations is expected soon.

(8) Graphical representation standards for chemical reaction diagrams (2003-045-3-800) (2012-033-1-800). This project remains a work in progress.

(9) Coordination polymers and metal-organic frameworks: Nomenclature guidelines (2009-012-200). This project has been published [*Pure Appl, Chem.* **85**(8),1715-1724 (2013)]. This is a jointly funded project of Divisions I, II, and VIII.

(10) Terminology and nomenclature of inorganic and coordination polymers (2011-035-1-800).

(11) Glossary of small molecules of biological interest (2009-022-2-800).

(12) Nomenclature of phosphorus-containing compounds of biochemical importance (2006-019-1-800).

Polymer projects with Division IV

(1) Source based nomenclature of single-strand organic polymers (2003-042-1-800). A very old project with recurring problems pf unacceptable names.

(2) Nomenclature and graphical representations for chemical-modified polymers (1999-051-1-800). The document "Nomenclature and graphic representations for chemically modified polymers (IUPAC Recommendations 2014)" was published in *Pure Appl. Chem.* 87(3), 307 - 319 (2015). It was published as the accepted version without having been returned to the authors after typesetting. A report has been submitted to IDCNS for review.

(3) Terminology and structure-based nomenclature for dendritic and hyperbranched polymers. (2001-081-1-800). These projects continue to be concerned with problems involving evolving organic nomenclature.

(4) Preferred names for polymers (2008-015-1-400). This is a list of preferred, acceptable IUPAC approved) and not acceptable (ambiguous, wrong or outdated) names for polymers.

(5) Revision of IUPAC Recommendations on Macromolecular Nomenclature – Guide for Authors of Papers and Reports in Polymer Science and Technology (2008-020-1-400). A final draft is being widely circulated for comments.

(6) Definitions and notations relating to stereochemical aspects in polymer science (2009-047-1-400). There has been no progress on this document during the past year.

(7) Guidelines for abbreviating polymer names (2006-004-1-400). The document 'Abbreviations of polymer names and guidelines for abbreviating polymer names (IUPAC Recommendations 2014)' has now been published (*Pure Appl. Chem.* 2014, **86**(6), 1003-1015.

(8) Structure-based-nomenclature for regular star and brush polymers (2013-031-3-800). A draft report has been generated.

Other projects in early stages of development

(1) End-of-line hyphenation of chemical names. As names grow longer, the problem of when is a hyphen an integral part of a name or when is it simply a separation of a word at the end of a line becomes more important.

(2) Nomenclature of carbon nanotubes and related substances and related substances

(3) IUPAC Color Book Data Management

(4) Nomenclature of Transition States and their Analogs for Phosphoryl Transfer Reactions.

(5) Protecting Group abbreviations.

Future project activities

(1) Liaison with the International Standards Organization (ISO).

(2) New edition of the 'Nomenclature of Inorganic Chemistry', looking at a possible 2019 publication.

(3) Graphical Representation of Polymers.

(4) Rotaxane stereochemistry.

(5) Nomenclature of delocalized systems.

(6) Crown nomenclature.

(7) A central web page for all IUPAC recommendations.

(8) Italic and Roman fonts.

This written report is authored by Warren Powell, March 9, 2015.

STRATEGIC PLAN
NTS

Robert H. Rich, Ph.D.
Director, Strategy Development
Office of the Secretary & General Counsel

Dear Staff Liaison Colleagues,

The *ACS Strategic Plan for 2015 and Beyond* has been released online at http://strategy.acs.org. The Board of Directors approved this new plan at its December meeting. Our Mission, Vision, Core Values, and Goals remain unchanged; however, this year we have new Objectives based upon the rapidly changing external environment that presents new challenges and opportunities. **As we continue our work, please think about how your committee's objectives and strategic direction can be brought into alignment with the overall plan for the Society. I encourage you to discuss the ACS strategy with your committees.**

We also have newly designed strategic plan pocket cards, which include the link to the full plan. I'd encourage you to share them with your committee members, so that they can take into consideration the plan's Objectives as they set strategy for the year. Please let me know how many cards you would like.

As in recent years, the Planning Committee is prepared to discuss the key trends affecting each committee's work with them, based upon our ongoing environmental scan. As we approach the Denver National Meeting, a new list of such trends is being developed.

As always, we welcome your thoughts about the forces affecting chemistry and the best ACS strategy to respond. Please email strategicplan@acs.org with your ideas. Thanks again for all you do to help the Society's strategic goals to become a reality.

Best Regards,
Bob

Robert H. Rich, Ph.D., CAE
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ACS Chemistry for Life
American Chemical Society

Help us to realize our vision and goals

American Chemical Society

ACS
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2015 ACS Environment Scan:

Committee on Nomenclature, Terminology & Symbols

ACS Board Standing Committee on Planning

March 2015

Context for Planning Committee Visit with NTS

- NTS Strategic Plan aligns with the ACS Strategic Plan
- Many external factors influence our path forward
- Environment scanning is critical to setting SMART goals and objectives
- An Environment Scan tells NTS what external forces impact NTS activities
- Role of Environment Scan in setting NTS goals and objectives
- Planning Committee's Ask

Context: The ACS Strategic Plan

ACS
Chemistry for Life®

ACS MISSION, VISION, AND CORE VALUES

CORE VALUES:

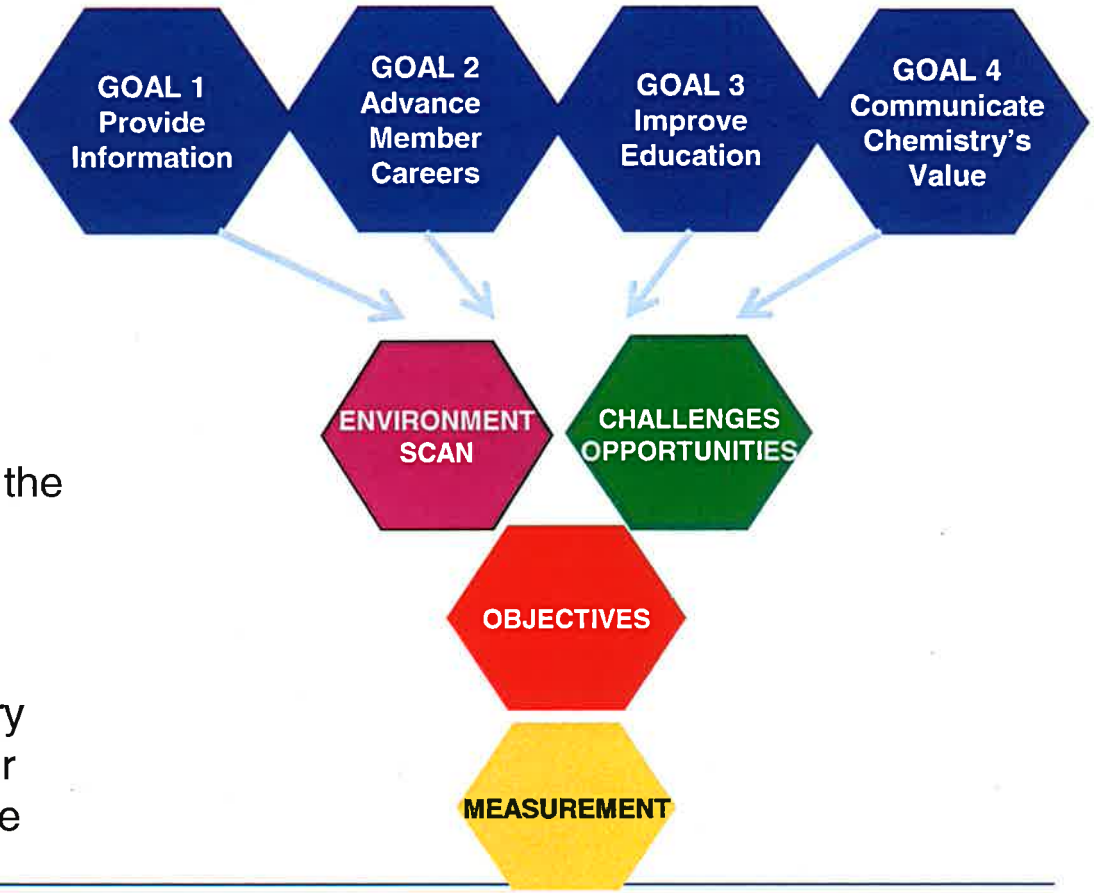
- Passion for chemistry
- Focus on members
- Professionalism
- Diversity and inclusion

VISION:

Improving people's lives through the transforming power of chemistry

MISSION:

To advance the broader chemistry enterprise and its practitioners for the benefit of Earth and its people



The Challenge – Strategic Planning for ACS Units: Optimizing Impact & Investment

Consistent with ACS Mission, Vision & Goals… & With Unit's Mission/Vision,

Use EScan & Unit Strengths/Weaknesses to Select Optimal Goals & Strategies

3-5 yr timeframe

6-18 mo. timeframe

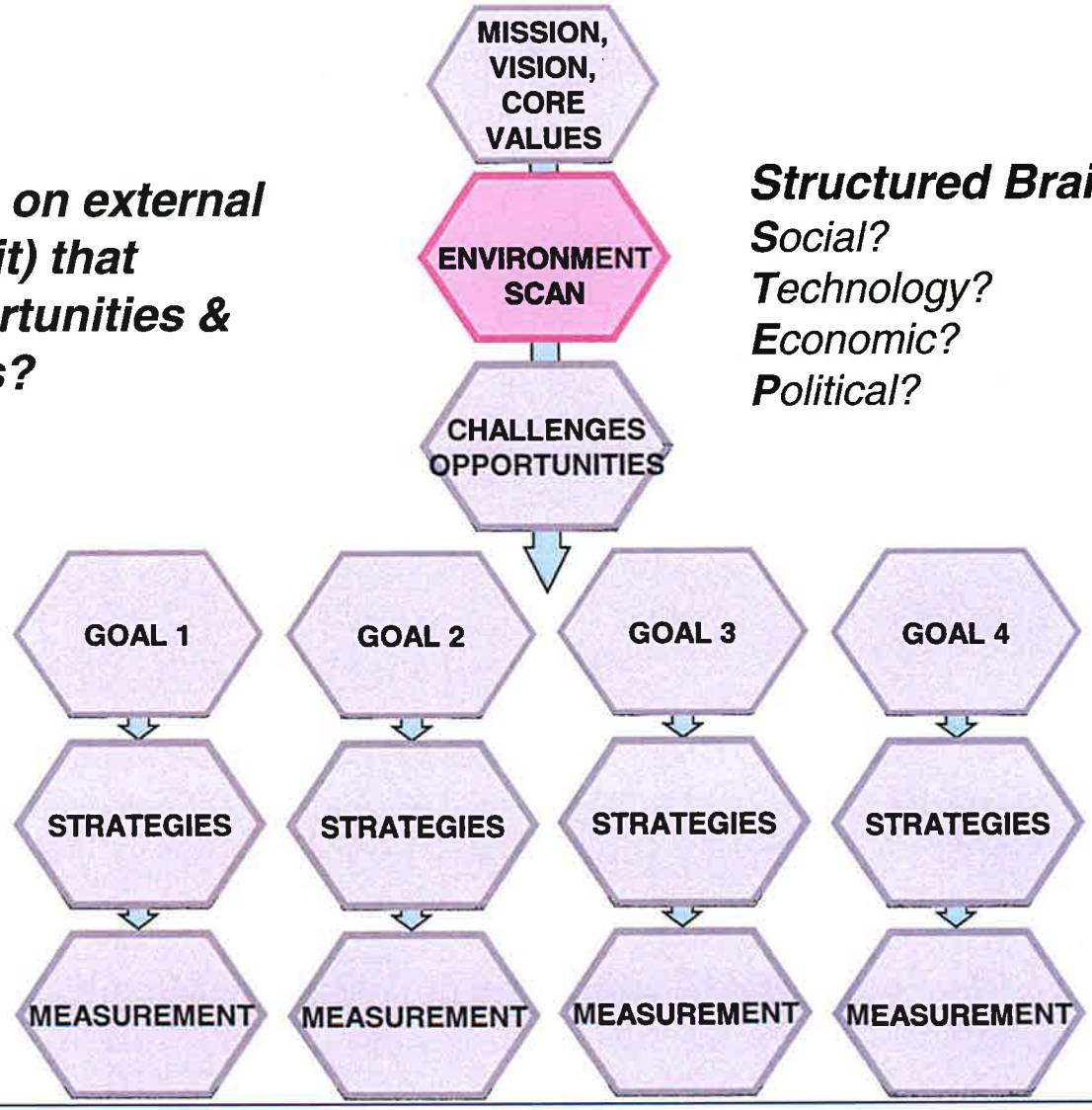
Environment Scanning – A Key Input to Strategy Development

- Continuously focuses on external forces
- Shows crucial factors affecting chemists, chemistry, and the ACS
- Addresses the short, medium, and long-term future
- Needs to be widely shared and understood by leaders
- Facilitates enhanced decision-making
- Leads to SMART goals and objectives
- Advances the Society's Mission and Vision

How Do We Do Environment Scanning?

ACS Chemistry for Life®

What's going on external to us (our unit) that creates opportunities & threats for us?



Structured Brainstorming:

Social?
Technology?
Economic?
Political?

What's So

Environment Scan 2015 – Key Trends

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Social

- Scientific enterprise globalization
- K-12 education trends
- Two-year college trends
- Politicization of science education
- Challenges in information/ knowledge/understanding
- Demographic shifts
- Changing career pathways
- Evolving meeting models

Technology

- Emerging genomics applications
- 3-D printing
- Social, mobile, cloud
- Cyber-security threats
- Online and other education tools
- Big data

Economic

- Lower oil prices
- Environmental concerns and responses
- Access to raw materials
- Middle class growth in BRICKS countries
- Increased use of adjunct and non-tenure track faculty

Political

- Global terrorism
- Public opposition to scientific knowledge
- Changing academic funding levels

Top Trends for NTS

1. Scientific enterprise globalization
2. Challenges in creating information, knowledge, and understanding
3. Emerging genomics applications
4. 3-D printing

Scientific Enterprise Globalization

1. More technology inventions and commercialization originating outside the United States
   - By non-U.S. citizens educated in the United States who returned to their native countries to start businesses?
2. More technology (and patent filings) coming into the United States originating elsewhere
   - Looking for access to the country and markets here
3. U.S. patents that stem from foreign origin/invention recently passed the 50% mark for the first time in history

The Question

- Have there been studies to estimate the **balance between the two technology flows**, and their economic impact, or can we suggest such studies?

Some Data

"One easy measure is the % of U.S. patents that stem from foreign origin, and we **recently passed the 50% mark** for the first time in history, i.e., most new U.S. patents originated from foreign invention."

"The >50% now includes issued patents and has included applications for about the past 5 years."

– Dennis Crouch, Associate Professor, University of Missouri School of Law

Challenges in Creating Information, Knowledge, and Understanding

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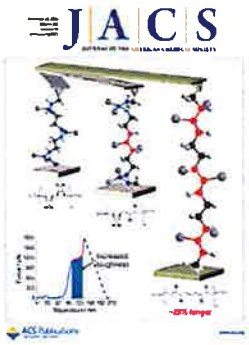
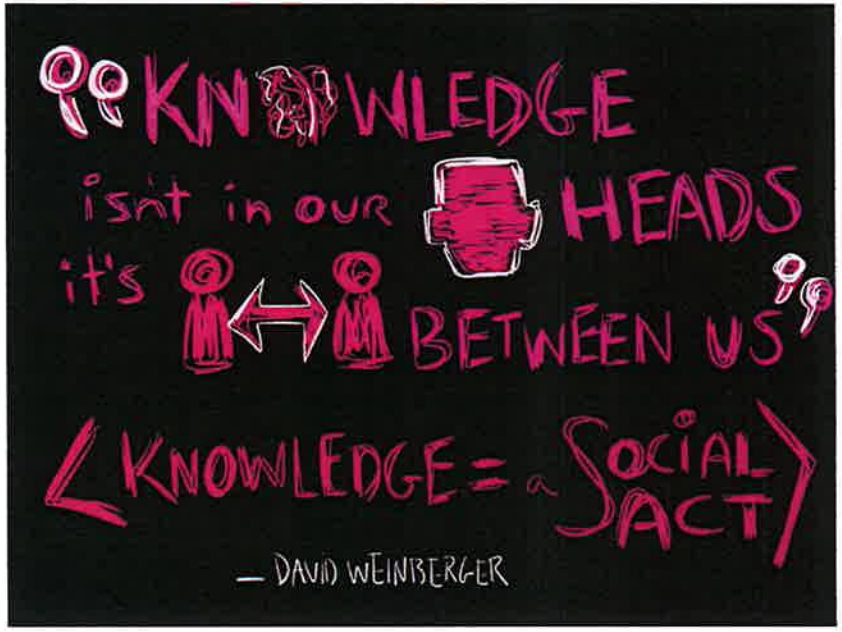
Data → Information → Knowledge → Wisdom → Understanding

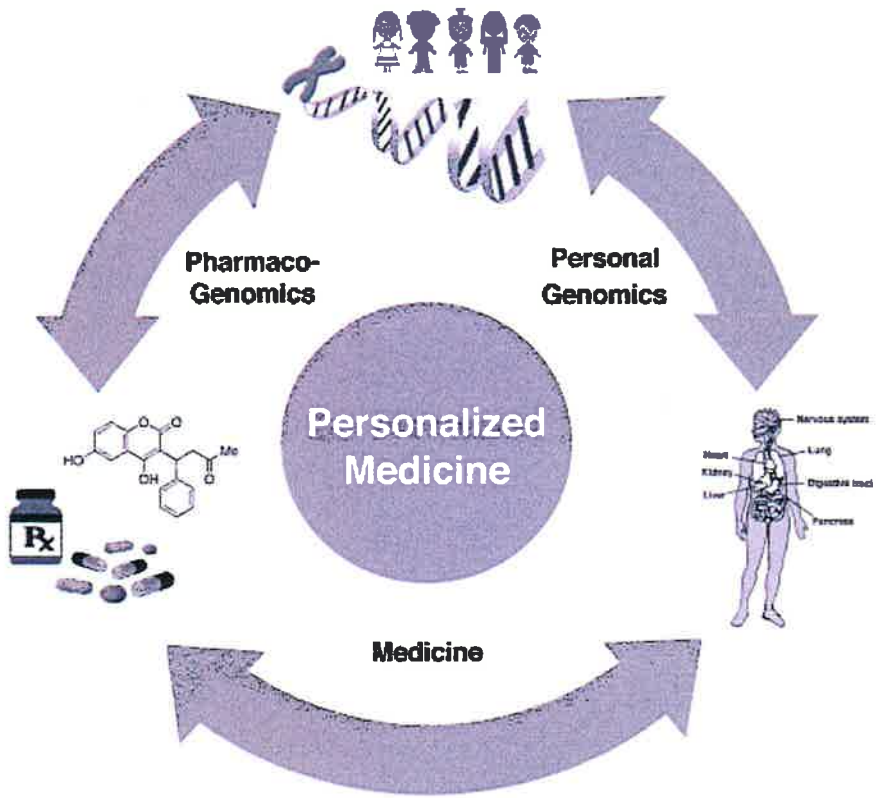


vs.



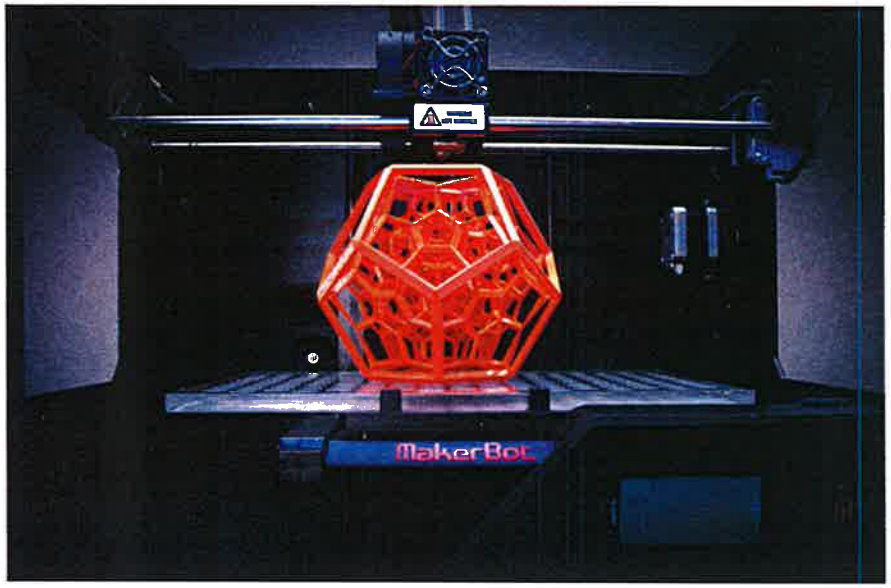
Emerging Genomics Applications

- Personal genome sequencing
- Gene therapy
- Genomics and healthcare
  - Personalized healthcare based on DNA data



3-D Printing

- Additive manufacturing
- 3D printing/synthesis replacing more traditional approaches.



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What Can You Do?

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- **Use the ACS Environment Scan to develop goals & objectives for your unit**
- **Provide Updates for ACS Environment Scan** (Email strategy@acs.org)
  - Trends that may impact ACS
  - Suggested Goals and objectives for ACS
  - Products/Services for ACS to consider offering

KG/MOLE

BACKGROUND FOR DISCUSSION IN DENVER

Al,

April 15 is a reasonable deadline for fulfillment. I could do something and two possibilities come to mind...

1. An update on the kilogram/mole

2. An exposure to the four Laws of Terminology that I'd like to draw attention to.

Paul

From:Svetlana N Korolev [mailto:skorolev@uwm.edu]
> Sent: Thursday, February 12, 2015 1:58 PM
> To: alfornow@sbcglobal.net; Fenske, Gerald Jr.
> Subject: ACS NTS updates for CIB
>
> Dear Dr. Censullo and Mr. Fenske,
>
> I am planning contents for a post ACS spring meeting issue of Chemical
> Information Bulletin (CIB), and would like to invite your article
> submission with updates of the ACS Committee on Nomenclature,
> Terminology and Symbols.
>
> Peter Rusch has provided several NTS reports to CIB in the past, e.g.:
> http://bulletin.acscinf.org/node/403
> http://bulletin.acscinf.org/node/334
> http://bulletin.acscinf.org/node/267
> http://bulletin.acscinf.org/node/54
>
> You are welcome to put the NTS updates in a broad perspective, e.g.
> the other ACS Committee overviews:
> on Ethics http://bulletin.acscinf.org/node/603
> On Patents and Related Matters http://bulletin.acscinf.org/node/268
>
> A deadline for article submissions will be April 15, 2015.
>
> Many thanks for your consideration of this matter. Please let me know
> of your decision regarding an article to be featured in CIB.

> Sincerely,
> Svetlana Korolev, editor
> http://bulletin.acscinf.org/

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American Scientist

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Weighing the Kilogram

Proposals to redefine this unit of mass and a related measurement, the mole, may be overlooking a clearer, simpler solution.

Paul J. Karol

Standards of measurement date back to James Clerk Maxwell, nearly one and a half centuries ago. Such standards guarantee uniformity and clarity for comparisons, an especially necessary ability owing to the global nature of the marketplace, technology, and research. Today, in the International System of Units (SI) there are seven base units that define physical quantities. These units include the second, meter, ampere, kelvin, and candela. But the final two have proven particularly problematic over the years: the kilogram (for the physical quantity "mass"), and the mole (for the physical quantity "amount of substance"—the name comes from "gram molecular weight"). Although it is widely accepted that the former needs a modification, there has been slow movement to do so.

Extreme precision in the measurement of all units is more than a semantic point. Improvements in measurement technology, combined with the fundamental properties of nature that can be revealed by nearly infinitesimally small changes in magnitudes, means that more and more precise standards are needed to extract knowledge from experimental determinations or from comparison with theories. The list of Nobel Prize winners is replete with recognition of major discoveries based on precision of the highest degree. Base units, upon which measurements are structured, not surprisingly have been undergoing modernization. But the kilogram and the mole have not been at the top of the list more because of controversy than lack of motivation.

The kilogram, and by extension the mole, are the only base units still tied to a physical object. For now, the 125-year-old kilogram definition is still anchored to a metal artifact: a platinum-iridium alloy cylinder that is kept under lock and key in a suburb of Paris. The mass of this standard kilogram seems to be changing at about the millionth of a percent level over about a century. The cause of this change is uncertain, but likely relates to periodic cleaning and calibration measurements. Small as it may seem, that change is enough to lend urgency to the campaign to redefine the kilogram.

To that end, a symposium on "The Kilogram and the Mole," sponsored by the president of the American Chemical Society, was held in San Francisco in 2010. There are now a number of formal proposals to redefine the kilogram, but I aim to demonstrate that some of the major options championed are grossly inappropriate. In 2011, Michael Kühne, then the director of the International Bureau of Weights and Measures (BIPM) spoke to the *New York Times* about the kilogram, saying that "the reason it hasn't been redefined before now is that nobody has come up with something better." I think that the BIPM has actually come up with something worse. This is the bureau's proposed new definition:

> The kilogram, kg, is the SI unit of mass; its magnitude is set by fixing the numerical value of the Planck constant to be equal to exactly $6.626069\ldots\times10^{-34}$ when it is expressed in the unit $s^{-1}m^2$ kg, which is equal to J s.

I would like to decode that definition, but even its proponents agree that is not a trivial task. What it comes down to is that a device called a watt-balance can be used to realize the connection between Planck's constant, h, the quantum of action in quantum mechanics, and the kilogram, based on an equation relating electrical and mechanical power that involves both that constant and the velocity of a mass moving under the influence of gravity. Making matters murkier, the suggestion has arisen to further constrain this definition in order to avoid the possibility that Planck's constant might vary as the universe evolves. To the above would be added the qualifying phrase for the Planck constant "being constant in terrestrial space and in the current era time frame."

Closely related to the kilogram issue is the one involving the mole. Up to now, the mole has been stipulated to be the number of atoms in exactly 12 grams of carbon-12. (*See "An Exact Value for Avogadro's Number," March–April 2007.*) Because it is defined in terms of grams, the mole is inextricably entangled with the kilogram. Under the new BIPM proposal, therefore, as the kilogram definition changes the mass of carbon-12 will also change, probably multiple times. Yet most recently, revisions in official atomic mass data by the International Union of Pure and Applied Chemistry still refer to the mass scale's foothold as embodied in carbon-12 having an atomic mass of exactly 12.

Proponents of the new SI definitions, such as the BIPM, have sought to bring the kilogram and mole in line with the other five standard units, make the com-

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plete set of fundamental physical quantities invariant and not based on artifacts. In other words, they aim to rationalize the entire international system of standard units. Quoting Ian Mills, president of the BIPM's Consultative Committee on Units: "The objective of the proposed changes is to adopt definitions referenced to constants of nature, taken in the widest sense, so that the definitions may be based on what are believed to be true invariants."

Prominent are the phrases "constants of nature" and "true invariants." The clearest examples of success here are the meter and the second, which are now infinitely precise and permanently defined in terms of integers. For instance, the meter is defined as the length of the path travelled by light in a vacuum during a time interval of 1/299,792,458 of a second. This part of the SI scheme has universal support, which is essential if it is to be extended to the remaining physical quantities. The widely accepted criteria for SI units include the following, according to Mills: the possibility of realization anywhere and at any time, at least in principle; based on commonly accepted laws in physics; and conceptually clear and easy to understand.

These are sensible and laudable goals. But the criteria and the objectives put forward by Mills seriously call into question the wisdom, if not the legitimacy, of the BIPM's very own proposed changes.

Robert Rathe

The United States's official kilogram, a cylinder of platinum-iridium alloy, is calibrated to the original, master version in France. Many countries maintain their own local copy for ease of comparison. The exact weight of a kilogram is one of the few measures tied to a physical object.

New Kilograms

There are actually two prominent, competing proposals for how to recast the kilogram. One is the "silicon sphere" (the Avogadro constant approach, related to the mole); the other is the "watt balance" (the Planck constant approach). The silicon sphere would use a softball-size orb of a single crystal of silicon-28, which has precise lattice spacing between atoms that, combined with Avogadro's number, would determine the exact size needed to measure 1 kilogram. In this way, it would maintain the reference kilogram as a physical object. The watt balance uses a moving coil to counteract the gravitational force on an object by electromagnetic induction. A truly ingenious, albeit very expensive device, the watt balance takes advantage of quantum electronic measurements involving g, the acceleration of a mass in the Earth's gravitational field, linking together the kilogram and Planck's constant.

The two proposals have been championed to different degrees by the BIPM, proposed for ratification first in 2005 and subsequently in 2011, but postponed because of discordant results between similar balance devices or between independent methods. Several attempts at constructing watt balance devices were abandoned because of the difficulty in achieving the desired precision. Commenting on a definition of the base unit in terms of h, Peter Becker, an expert consultant to the Consultative Committee, reminds us that mass, like the other base units, is a classical concept whereas a definition relating it to the Planck constant will depart from classical physics. Defining a base unit just because its realization invokes modern quantum metrology intimates that the tail is beginning to wag the dog.

In fact, both approaches have serious shortcomings. Rather than advocating either, the BIPM should have resoundingly discarded them together as not satisfying the objective agreed on: "constants of nature" and "true invariants."

In the case of the silicon sphere with its chemically reactive surface, even if isotopic purity (100 percent silicon-28) is approached, the kilogram would still be based on an artifact. Natural silicon is 92 percent silicon-28. Russian laboratories have provided kilogram quantities of silicon enriched to 99.99 percent at high cost. The surfaces are oxidized. Isotopic analyses by different techniques have produced significantly different results for the composition. Yet the most precise value to date for experimentally determining Avogadro's number has been extracted from the latest silicon sphere measurement based on precise isotopic masses for silicon compared to carbon-12.

The watt balance is predicated on an even more troublesome artifact. Gravitational acceleration is permanently encumbered with a limit of parts-per-billion precision. The proponents of the watt balance approach admit that the lunar cycle and tides affect their measurements, although the corrections are confidently manageable. Local gravitational acceleration (g, not to be confused with the fundamental gravitational constant, G), of course, is also affected by distribution of mass and by geographical location of the apparatus. Earthquakes, volcanic eruptions, and seasonal hydrology have the largest correctional influence. The 2010 Chilean and 2011 Tohoku earthquakes are reported to have altered the planet's revolution period, which in turn changes gravitational acceleration at the parts-per-billion level.

Also, landmasses rising and falling and ice caps melting with seasonal temperature changes; polar motions; atmospheric pressure; depth of the local water table; and even human activities affect gravitational acceleration. The crustal lithosphere is constantly stirring around. The planet's convecting magma below the crust continually and unpredictably (unlike tides and lunar orbits) affect gravitational acceleration in degrees that will continually modify the results of measurements. Global climate changes affect sea levels. Gravitational shifts occur on time scales ranging from minutes

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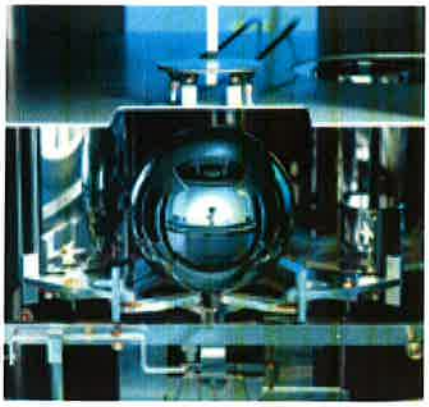


Andrew Brookes/NPL/Science Source

One suggestion for a replacement of the kilogram involves the use of an extremely precise sphere of silicon-28. However, this approach would still tie the kilogram to a physical object.

to years and spatial extents from meters to global. And that's just on Earth—on whose mass distribution the watt balance is inescapably based—the largest artifact imaginable! The watt balance does not satisfy the BIPM/SI constraints. The Earth's gravity is neither a "constant of nature" nor a "true invariant."

The BIPM should have been aware of their transgression beforehand. James Clerk Maxwell said at the 1870 meeting of the British Association for the Advancement of Science:

> If, then we wish to obtain standards of length, time, and mass which shall be absolutely permanent, we must seek them not in the dimensions, or the motion, or the mass of our planet, but in the wavelength, the period of vibration, and the absolute mass of these imperishable and unalterable and perfectly similar molecules.

This cogent quote followed an astute observation by Maxwell that seems to have been overlooked by the metrology community:

> Yet, after all, the dimensions of our earth and its time of rotation, though, relatively to our present means of comparison, very permanent, are not so by physical necessity. The Earth might contract by cooling, or it might be enlarged by a layer of meteorites falling on it, or its rate of revolution might slowly slacken, and yet it would continue to be as much a planet as before. But a molecule, say of hydrogen, if either its mass or its time of vibration were to be altered in the least, would no longer be a molecule of hydrogen.

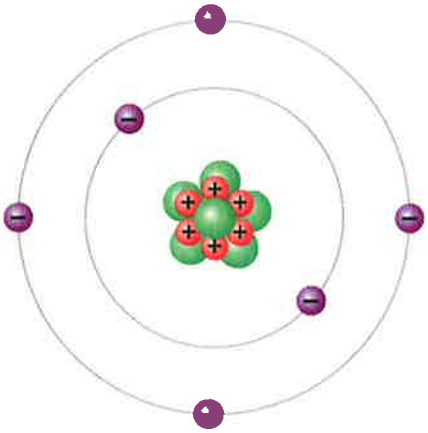
In 2005 and 2006, theoretical physicist Frank Wilczek published a series of brief, thoughtful essays on absolute physical units emphasizing, among other things, relationships among them. Much of his presentation dealt with units of length, time, and mass. Wilczek noted as an illustration that units must be such that one could communicate information, such as body mass, with a correspondent anywhere—on the Moon or even in the Andromeda galaxy—by simply transmitting pure numbers. No such hypothetical exchange of information on mass would be possible under the BIPM proposal, making it a choice that is uniquely and disadvantageously confined in both geography and time. Furthermore, length (the meter), time (the second), and mass (the kilogram) are all comprehensible phenomena to the general public, but the BIPM-proposed kilogram definition is undeniably obtuse, stifling clarity and visualization.

Constant Carbon

An essential insight with respect to the mass fundamental unit is the following dictum: There is, in practice, absolutely no need for parts-per-billion precision in a macroscopic mass such as embodied in the current standard kilogram. But in keeping with the philosophy of the meter and second, there is a need for an equivalently precise fundamental mass standard. Fortunately, such a standard can be quite elegantly and simply instituted microscopically, where it is needed, without the ambiguities and complexities inherent in either of the BIPM proposals. An atomic scale that has the mass of a carbon-12 atom being exactly 12 atomic mass units can be related to the kilogram through Avogadro's number.

The kilogram, and by extension the mole, are the only base units still tied to a physical object.

Current measurement techniques have yielded better than parts-per-billion precision masses of atoms, and even the electron and the muon, all relative to carbon-12. Measurements can be on one atom at a time. The mass of carbon-12 is an invariant of nature. Ubiquitous carbon-12 requires no upkeep or security precautions. It would seem, though, that the proposed carbon-12 alternative leaves us with an impractical dilemma: macroscopic mass. But one mole of carbon-12 atoms has a mass of exactly 12 grams, providing a macroscopic connection to the unified atomic mass. Although somewhat arbitrary, this longstanding dictum is nevertheless an intuitive and understandable option.



If the atomic weight of an atom of carbon-12 were defined as exactly 12 atomic mass units, this mass could then be related to the kilogram—an approach the author advocates.

More problematic, it might initially seem, is the mole. Currently, "the mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12." A proposal considered by the BIPM offered the mole as "the SI unit of 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 numerical value of the Avogadro constant to be equal to exactly $6.022141079\ldots\times10^{23}$ when it is expressed in the unit mol^{-1}."

I have a simple solution. The mole, also known to many as Avogadro's number, should be regarded not as a physical constant, but rather as a numerical constant. It is, in the simple scheme of things, the quantitative gauge that links two mass scales, microscopic and macroscopic. The mole does not belong on the list of SI base units for physical quantities (and, in fact, was added to that list only in 1971). To some, such a suggestion is horrifying, chafing at the drilled-in and deeply entrenched notion that the mole is a physical unit, a must for the chemical amount of substance, rather than a

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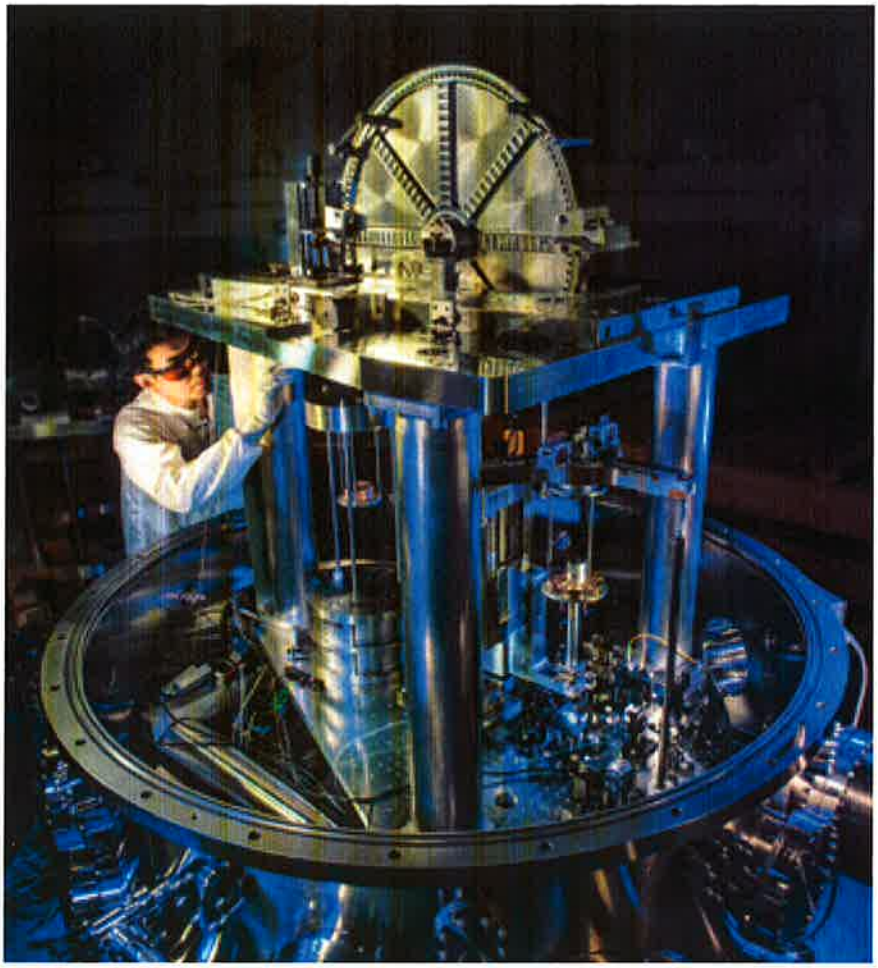

A device called a watt balance, shown here at the National Institute of Standards and Technology, counteracts the gravitational force on an object by electromagnetic induction, and could be used to define the kilogram. However, its operation is tied to Earth's gravity. (Photograph courtesy of NIST.)

numerical quantity. But if we describe three dozen eggs, we symbolically, if not actually, calculate 3×12. When we talk about three moles of methane, we symbolically conjure up 3×Avogadro's number of methane molecules. The mole is a number: That number of carbon-12's defines 12 grams, which in turn gives us the route to defining an invariant kilogram: a constant of nature through the fact that carbon-12 is invariant.

The platinum-iridium metal artifact that currently defines the kilogram, along with all its hundred or so near-clones, in this alternative view become secondary global standards, reference materials, precise to better than 0.1 parts-per-million, sufficient if not well beyond what is necessary in the practical world for now, in the past, and in the foreseeable future. The kilogram as an SI fundamental physical unit becomes defined as the mass of exactly (1,000/12)×Avogadro's number of carbon-12 atoms. Certainly, this value is an analog to the definition of a meter as related to the speed of light in a vacuum.

Giving "the mole" its due recognition as a number, removing it from the SI list of fundamental physical units, and establishing carbon-12 as the basis of an SI mass system meets the BIPM objective and satisfies the criteria. Moreover, returning to methane to illustrate this point, both "3 moles" of methane and "0.04813 kilograms" of methane conjure up the same thing, an amount of the substance methane.

In the future, instrumentation connecting time and mass is likely to play a role in the kilogram–mole connection. The Compton clock, a device taking advantage of *atom interferometry*, has recently been constructed and successfully operated. This clock splits a quantum matter wave of a single cesium-133 atom in two, one of which remains stationary. The device uses a laser to compare the phase difference between the beams, and this frequency relates directly to the mass of the atom.

The scheme would provide an absolute measurement of a cesium-133 atom's mass to an accuracy of 4 parts per billion, which is competitive with other methods and more accurate than in the present SI. The mass determined is an inertial mass, as opposed to the seriously problematic gravitational mass that the watt balance method weighs. Other microscopic masses can be related to cesium, but it remains to be seen how readily and rapidly available such a device might become.

The Wider Community

The redefinitions of the kilogram and mole directly affect chemistry, physics, biology, and the medical sciences, but the BIPM's deliberations have been largely confined to the community of metrologists. Plainly, it behooves such an international effort, founded on diplomatic agreement, to proactively involve the wider user community.

Indeed, the director of the BIPM, in a February 20, 2011, letter to the *New York Times* declared "The redefinition is not being held up by the question of whether it should be based on the Planck constant or the Avogadro constant. That issue has been resolved in favor of the Planck constant." After a significant number of scientific publications aired unhappiness about the proposed revision, two members of the International Union on Pure and Applied Chemistry responded: "Given that the decision to adopt the New SI is in effect a *fait accompli*, due to the authority vested in the BIPM set up by the Metre Convention of 1875 and amended in 1921, those affected will have to adapt to live with the new system."

That vexing dismissiveness could be excused if "those affected" had been generally made aware of the new SI proposals and given an opportunity to participate in developments. The good news is that the new standard is not, in fact, a *fait accompli*. There is time for a wide-reaching discussion to take place. I urge the BIPM to make every effort to ensure that input is received and heard.

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Kate-

NTS has discussed our response to your request for input, with regards to the recent IUPAC memo on the mole and amount of substance. We decided to put our response into the form of a loose narrative, structured around the original four item questionnaire.

I hope the information in our reply will be helpful to you. Of course, feel free to contact me if you require additional information or support.

If you could send me a quick response back, letting me know that you received this file, I would appreciate it. My email has lately been fussy about sending/not sending messages.

Al Censullo
Chair, ACS Committee on Nomenclature, Terminology, and Symbols

Note to readers: This response was sent to

Kathryn Hughes
Sr. Program Officer
Board on Chemical Sciences and Technology
The National Academies

NTS Responses to the IUPAC Questionnaire†

1) Are you satisfied with the current definition of mole?

a) No; however, chemists have lived with it for over 40 years, so they certainly can live with it.

b) "Amount of substance" is a term that is not widely used by practicing chemists nor others in allied chemical fields. (See below under questions 3 & 4.)

c) See 2c below.

2) Are you satisfied with the new definition proposed for the mole?

a) The proposed definition is better than the current one; however, it still refers to the quantity "amount of substance", deemed unsatisfactory even by the BIPM.

b) The proposed definition[1] is closer to the definition given in many introductory chemistry textbooks. The latter tend to define the mole as Avogadro's number[2] of elementary entities. The fixed-constant definition of the mole is closer than the current definition to this current practice in chemical education and chemistry allied fields such as the health professions.

c) The mole need not be included as a unit in the SI and was not until 1971; it will continue to be used by chemists. A definition that reflects widespread usage by chemists and chemistry educators is "The mole contains exactly 6.022 141 29 $\times 10^{23}$ specified entities." [As a practical matter, in the context of chemistry, those entities will be "atoms, molecules, ions, electrons, other particles, or specified groups of such particles" as specified in the current SI Brochure[3].]

3) Are you satisfied with the current definition of amount of substance?

a) No.

b) The current SI Brochure[3] states "The quantity used by chemists to specify the amount of chemical elements or compounds is now called 'amount of substance'. Amount of substance is defined to be proportional to the number of specified elementary entities in a sample, the proportionality constant being a universal constant which is the same for all samples." The IUPAC Gold Book[4] adds "Since it is proportional to the number of entities, the proportionality constant being the reciprocal Avogadro constant and the same for all substances, it has to be treated almost identically with the number of entities." Many chemists and chemistry educators consider the quantity of which mole is a unit to be the number of entities, and they do not observe a distinction between proportionality to and identity with number of identities. Furthermore, the first sentence quoted from the SI Brochure has a serious factual problem: the quantity used by chemists to specify the amount of chemical elements or compounds is ***not*** generally called amount of substance.[5]

c) See 4c below.

4) Are you satisfied with the current name of amount of substance?

a) No.

b) The name is ambiguous. Mass, volume, and number of entities are all measures of the amount or quantity. Whatever the name of this quantity, its determination is commonly made by measurement of mass ('counting by weighing')

c) "Number of entities" is a clearer name for what practicing chemists think the mole measures. If a distinction must be made between a purely numerical quantity (like a dozen or gross) and a quantity that is proportional to number of entities—a distinction chemists and chemistry educators tend not to observe—then a name free from the word "amount" ought to be chosen. After all, the word "amount" is used for different entities in the SI Brochure[3] ("amount of heat" and "amount of electricity" as well as "amount of substance"). If the term "amount of substance" is retained, the option of dropping "of substance" ought not to be countenanced, as it is in the current SI Brochure. (And if "amount of substance" is retained, it is likely to continue to be used by chemists as infrequently as it is today.) And if the term "amount of substance" is retained, then the preferred formulation from Question 2c above would become "One mole is the amount of substance containing exactly $6.022\ 141\ 29 \times 10^{23}$ specified entities."

The Kilogram

While the input from NTS on the kilogram was not sought at this time, its definition has received much attention from this committee in recent years. The Committee has noted the importance of maintaining the "compatibility condition"[6] that exists in the current SI which links Planck's constant, Avogadro's constant, and the mass of the carbon-12 atom.

In its simplest form, this compatibility condition requires that $h\,N_A = K_c M(^{12}C)$, where K_c is a combination of other well-characterized constants. From this relationship, it is clear that any two (and ONLY two) of the three quantities (Planck's constant, Avogadro's constant, and the mass of carbon-12) may be fixed. Affirming the carbon-12 atomic mass as exactly 12 would require either h or N_A to be determined experimentally. Fixing N_A would produce a conceptually simple, readily achievable alternative to the proposed definition for the kilogram as $\left(\frac{1000}{12}\right) \times 6.0221014129 \times 10^{23}$ times the mass of an atom of ^{12}C (at rest and in the ground state). Surely the mass of the ^{12}C atom is a true invariant, and one that has served chemists and physicists well as the basis of the unified atomic mass scale.

The proposed indirect definition of the kilogram via the Planck constant seems to us unnecessarily complex in practice, if not in principle, and presents a high hurdle in explaining this definition to the users of the new SI. The early architects of the new SI indicated that any redefinitions should be "readily comprehensible to students in all disciplines"[7]. We are convinced even the strongest proponents of the new SI will agree that this condition has not been met. In contrast, a carbon-12 based kilogram could produce an eminently teachable statement such as: " Avogadro's number, or one mole, of carbon-12 atoms has mass of exactly (12/1000) kilograms".

In addition to these issues, NTS also notes some technological concerns with the currently favored mise en pratique for the kilogram. Those issues have been addressed by others.

Footnotes

[†] In 2010, the IUPAC Executive Committee formally recommended adoption of the new definitions (Chemistry International vol. 32 no. 1) under examination here, following limited consultation with the user community. The ACS Committee on Nomenclature, Terminology, and Symbols is grateful for this opportunity to contribute on behalf of the American Chemical Society.

[1]Bureau International des Poids et Mesures, *Draft 9th SI Brochure 16 December 2013*, http://www.bipm.org/utils/common/pdf/si_brochure_draft_ch123.pdf

[2]Note that chemical usage in textbooks and in research papers strongly prefers "Avogadro's number" to the "Avogadro constant." A search of pubs.acs.org turned up 1606 research papers published in ACS journals since the year 2000 that contain the phrase "Avogadro constant" or "Avogadro's constant." The comparable number of research articles containing "Avogadro's number" or "Avogadro number" was 6022.

[3]Bureau International des Poids et Mesures, *The International System of Units (SI)*, 8th ed., Organisation Intergouvernementale de la Convention du Mètre, 2006, http://www.bipm.org/utils/common/pdf/si_brochure_8_en.pdf

[4]IUPAC. Compendium of Chemical Terminology, 2nd ed. (the "Gold Book"). Compiled by A. D. McNaught and A. Wilkinson. Blackwell Scientific Publications, Oxford (1997). XML on-line corrected version: http://goldbook.iupac.org (2006-) created by M. Nic, J. Jirat, B. Kosata; updates compiled by A. Jenkins. ISBN 0-9678550-9-8. http://goldbook.iupac.org/A00297.html

[5]A search of pubs.acs.org turned up 413 research papers published in ACS journals since the year 2000 that contain the phrase "amount of substance". The comparable number of research articles containing "number of moles" (the term given in the Gold Book as the former name for amount of substance) was 4436.

[6]B. Leonard, *Metrologia* **43**, L3-L5 (2006)

[7]I.M. Mills, P. Mohr, T. Quinn, B. Taylor, and E. Williams, *Metrologia*, **43**, 227-246 (2006)

NTS statements for consideration

1. On the mass of ^{12}C
   Preferred: the mass of ^{12}C is exactly 1000/12 kilogram

2. On the Avogadro's constant

   Preferred: Avogadro's number, N_{Avo}, is exactly equal to $6.022\ 141\ 29 \times 10^{23}$

   Acceptable: The Avogadro constant, N_A, is exactly equal to $6.022\ 141\ 29 \times 10^{23}$ $mole^{-1}$

3. On the mole

   Preferred: The mole need not be included as a unit in the SI; it will continue to be used by chemists in the current sense

   Acceptable: The mole is the amount of substance such that the Avogadro constant, N_A, is exactly equal to $6.022\ 141\ 29 \times 10^{23}$ $mole^{-1}$

4. On the kilogram

   Preferred: The kilogram, unit of mass, is the mass of $6.022\ 141\ 29 \times 10^{23}$ unbound ^{12}C atoms, at rest, and in the ground state.

Mole is the name of the SI base unit (symbol mol) for the base quantity *amount of substance* (symbol n) which is defined in IUPAC documents (e.g. IUPAC Green Book, 3rd Edition, 2nd Printing 2008 [4]) using the expression $n = N/N_A$, where N is the number of entities, and N_A is the Avogadro constant. Similarly, the SI Brochure (8th Edition 2006 [2]) provides the following definition of the quantity *amount of substance*:

> "Amount of substance is defined to be proportional to the number of specified elementary entities in a sample, the proportionality constant being a universal constant which is the same for all samples ... This constant is called the Avogadro constant, symbol N_A or L ... the relation is $n = N/N_A$. ... the Avogadro constant has the coherent SI unit reciprocal mole."

QUESTIONNAIRE

IUPAC NAOs are hereby asked the following:

1. Are you (as NAO representing your members) satisfied with the <u>current definition of the mole</u>?
   a. YES or NO?
   b. If NO, please specify in a few sentences why you opted for NO.
   c. If NO, please provide some suggestion on what to change.
2. Are you (as NAO representing your members) satisfied with the <u>new definition of the mole</u> as proposed by the 24th General Conference of Weights and Measures?
   a. YES or NO?
   b. If NO, please specify in a few sentences why you opted for NO.
   c. If NO, please provide some suggestion on what to change.
3. Are you (as NAO representing your members) satisfied with the <u>current definition of the quantity</u> amount of substance?
   a. YES or NO?
   b. If NO, please specify in a few sentences why you opted for NO.
   c. If NO, please provide some suggestion on what to change.
4. Are you (as NAO representing your members) satisfied with the <u>current name of the quantity</u> amount of substance?
   a. YES or NO?
   b. If NO, please specify in a few sentences why you opted for NO.
   c. If NO, please provide a suggestion for a new name.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

A critical review of the proposed definitions of fundamental chemical quantities and their impact on chemical communities

Objective: The objective of this task is to provide a Technical Report containing a critical review of the definitions for the quantity amount of substance and its unit, mole, as well as the related unit of the quantity mass.

Project No.: 2013-048-1-100

Start date: 2013-12-01

End date: 0000-00-00

Division: Physical and Biophysical Chemistry Division

Description: The work will consist on the compilation of existing published work related to the definition of the quantity amount of substance, its unit, and the consequence of these definitions on the unit of the quantity mass. The compilation will be reviewed critically with the aim of assembling all possible elements such as to enable to judge on the adequateness of the existing definitions or new proposals. Compilation and critical review shall rely on the broadest spectrum of interested IUPAC members. Therefore, all divisions will be offered to participate at the project, as well as ICTNS and CCE. All task group members will have a mandate to speak on behalf or their corresponding communities. External experts will be consulted.

The task group is timely scheduled with discussions in CCQM and BIPM on the new definition of the mole. A time horizon of 2015 for establishing a firm position of IUPAC with regard to this question is adequate for further decisions to be taken by CCQM, CIPM, and CGPM.

Progress: *June 2014 update* - The task group initiated a survey to collect opinions and comments by the IUPAC National Adhering Organizations (NAOs). The questionnaire focuses on the current definition of the mole, the new definition of the mole, the current definition of the quantity amount of substance, and the current name of the quantity amount of substance.

Because of external time-constraints, IUPAC NAOs are asked to reply no later than 1 October 2014. See questionnaire [pdf file - 90KB]. All comments will be used towards formulating the IUPAC Technical Report. Those organizations who will reply will be sent an advance draft of the IUPAC Technical Report for further comment and input before submission to *Pure and Applied Chemistry*.

Because of external time-constraints, Chemical Societies represented by IUPAC NAOs are asked to reply no later than 2014/October/01. The replies should be drafted on a letterhead, signed, and sent in as a PDF format to mole@iupac.org. The comments will be used towards formulating the IUPAC Technical Report. Those organizations who will reply will be sent an advance draft of the IUPAC Technical Report for further comment and input before submission to *Pure and Applied Chemistry*.

Prof. Dr. Jürgen Stohner FRSC
Chairman of the Task Group

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[1] http://www.bipm.org/en/si/new_si/
[2] http://www.bipm.org/en/si/si_brochure/
[3] http://www.bipm.org/en/CGPM/db/24/1/
[4] http://www.iupac.org/home/publications/e-resources/nomenclature-and-terminology/quantities-units-and-symbols-in-physical-chemistry-green-book.html

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A CRITICAL REVIEW OF THE PROPOSED DEFINITIONS OF FUNDAMENTAL CHEMICAL QUANTITIES AND THEIR IMPACT ON CHEMICAL COMMUNITIES

2014/Jun/03

To all Chemical Societies represented by
IUPAC National Adhering Organizations

Dear Sir or Madam:

INTRODUCTION

In light of the proposed revision of the International System of Units (SI) [1], IUPAC has launched a project with the task to provide a Technical Report containing a critical review of the definitions for the quantity amount of substance and its unit, mole, as well as the related unit of the quantity mass. This letter is to collect opinions and comments by the IUPAC National Adhering Organizations (NAOs) which will be reproduced in the aforementioned Technical Report.

HISTORY

In 1971, the 14th General Conference of Weights and Measures resolved to define the mole as "the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12..." In addition, "when the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles." This is the current definition of the mole [2].

In 2011, the 24th General Conference of Weights and Measures proposed a revision of the SI. As a consequence of this, the redefinition of the mole is necessary and its magnitude will be set "by fixing the numerical value of the Avogadro constant to be equal to exactly 6.022 14X × 10^{23} when it is expressed in the SI unit mol^{-1}." The symbol X represents one or more additional digits to be added to the numerical value of N_A. This is the proposed new definition of the mole [3].

Realizing the second opportunity for chemists to re-think the mole

Paul De Bièvre

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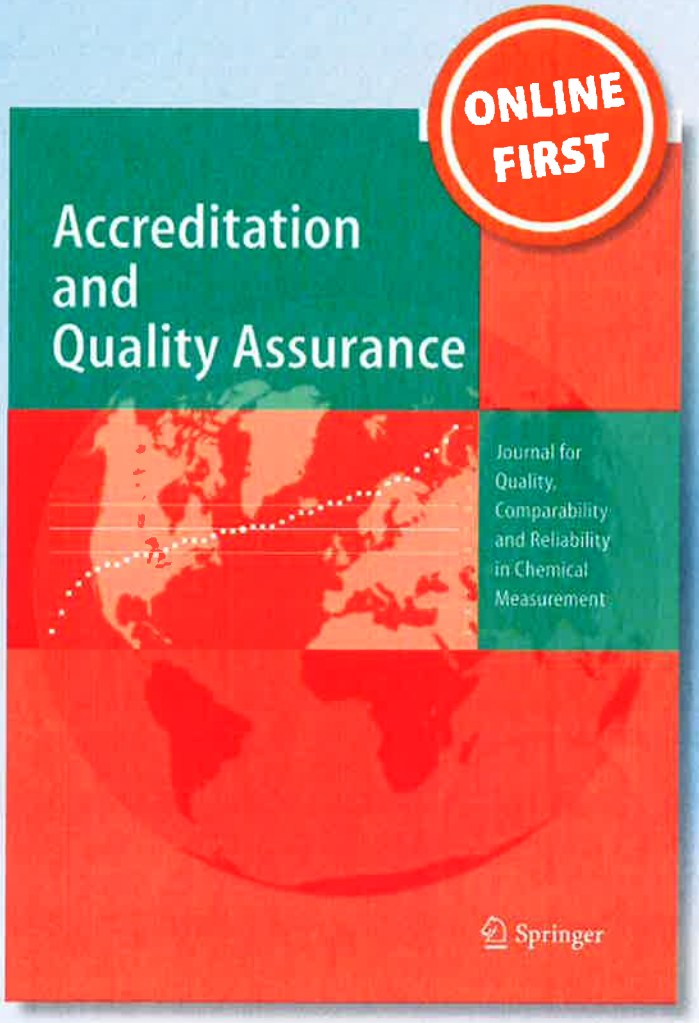

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PAUL'S COLUMN ON MIC

Realizing the second opportunity for chemists to re-think the mole

Paul De Bièvre

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A project of the International Union of Pure and Applied Chemistry (IUPAC) announced previously [1] has now reached the stage of formal interdisciplinary consultation. The task is: "A critical review of the proposed definitions of fundamental chemical quantities and their impact on chemical communities" and will lead to a formal report. The project is described on the website of the IUPAC [2].

The constitution of the project team is given hereafter:

J Stohner, Secretary IUPAC Division I, Physical and Bio-Physical Chemistry, Task Leader, R Marquardt, President IUPAC Division of Physical and Bio-Physical Chemistry, J Meija, President IUPAC Commission of Isotope Abundances and Atomic Weights, Z Mester, IUPAC Analytical Chemistry Division (ACD), M Towns, IUPAC Commission on Chemical Education, R Weir, President IUPAC Interdivisional Committee on Terminology, Nomenclature and Symbols (ICTNS).

The project group has initiated a procedure to collect opinions and comments from the constituting organizations of IUPAC, i.e., from the National Adhering Organizations (NAOs) [3]. The questionnaire focuses on the current definition of the mole, the new definition of the mole, the current definition of the quantity amount of substance, and the current name of the quantity amount of substance. IUPAC NAOs are asked to reply no later than 1 October 2014. All comments will be used toward formulating an IUPAC Technical Report. Those organizations which will reply will receive an advance draft of this IUPAC Technical Report for further comment and input before it is submitted to *Pure and Applied Chemistry*.

Until recently, the main actors in most discussions of a redefinition of the mole (and of other SI units) have been to a large extent physical chemists and SI Officers in the Consultative Committee for Units (CCU) to the International Committee for Weights and Measures (CIPM) and from there to the General Conference on Weights and Measures (CGPM). Also the Consultative Committee for Amount of Substance—Metrology in Chemistry and Biology (CCQM) devoted some discussion to the topic, most recently with a CCQM Workshop on the mole (April 2014). Unfortunately, analytical chemists did not take very much notice of the ongoing discussions despite the encouragements of the CCQM and the CCU, nor did Chemical Societies: The IUPAC ACD made its first statement to that effect in 2012. So did the IUPAC Commission on Isotope Abundances and Atomic Weights, (CIAAW) in 2011. In 2013, an article was published for the information of the Analytical Chemistry Division of the European Association for Chemical and Molecular Sciences (EuCheMS) [4].

Therefore, all readers of ACQUAL are strongly encouraged to contact their chemical societies as well as their National Adhering Organizations to IUPAC, which meet at the IUPAC Council Meeting of the biennial IUPAC General Assembly (next one: August 2015 in Pusan, Korea), and make their voices and opinions heard and considered (by 1 October 2014). So should EuCheMS.

Finally, all should realize that a fruitful in-depth discussion and redefinition of the unit mole cannot possibly

Disclaimer The author is a member of the Joint Committee on Guides for Metrology (JCGM) and Working Group 2 (VIM). The opinions expressed in this Column do not necessarily represent the view of the Working Group or of ACQUAL.

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Published online: 19 August 2014

Author's personal copy

take place without a thorough re-examination of the confusing concept "amount of substance," the quantity of which the mole is the unit, and which is so difficult to teach according to many educators in chemistry as reflected in various publications, e.g., in the Journal of Chemical Education. Extensive literature on the matter has been assembled in [5] (two rubriques: "Documents" and "Ed-Ops") as well as in a special issue of this journal [6], but also in the journal *Metrologia* since several years.

As usual, any comment, question, or amendment is welcome, preferably as a contribution to the Discussion Forum of this Journal.

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TASK FORCE NEW SI

From: Carmen Giunta [mailto:giunta@lemoyne.edu]
Sent: Friday, February 20, 2015 2:19 PM
To: Albert C. Censullo
Cc: Dr. Jack Secrist; Dr. Paul Karol; Fenske, Gerald Jr.
Subject: Re: second call for agenda items

Hot off the electronic presses of Metrologia is this article proposing some clarifications on how to treat quantities of dimension 1, including numbers of atoms and molecules. The article is mainly about angles (degrees, radians, cycles, and related quantities), but section 5 treats counting quantities. Equation 32 is of particular relevance to NTS discussions about the mole and Avogadro's number. It looks to me like equation 32 is exactly the definition of the mole that we advocate, an explicit equation of a mole to a specific number of entities.

I don't propose to make this an item of discussion at Denver, but perhaps an item of information. It is probably useful information to have a pair of NIST metrologists on record as stating that a mole is a number of entities.

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Dimensionless units in the SI

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Dimensionless units in the SI

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Abstract

The International System of Units (SI) is supposed to be coherent. That is, when a combination of units is replaced by an equivalent unit, there is no additional numerical factor. Here we consider dimensionless units as defined in the SI, e.g. angular units like radians or steradians and counting units like radioactive decays or molecules. We show that an incoherence may arise when different units of this type are replaced by a single dimensionless unit, the unit 'one', and suggest how to properly include such units into the SI in order to remove the incoherence. In particular, we argue that the radian is the appropriate coherent unit for angles and that hertz is not a coherent unit in the SI. We also discuss how including angular and counting units affects the fundamental constants.

Keywords: SI, international system of units, dimensionless units, radian, hertz

A parable of dimensionless units

Bert has a turntable operating at a rotation frequency of $33\frac{1}{3}$ revolutions per minute. His friend, Ernie, asks Bert, 'At what frequency is your turntable rotating?' If Bert were to answer '0.555 Hz' Ernie would know the rotation frequency. Similarly, if Bert were to answer '3.49 radians per second', Ernie would know the rotation frequency. And, if Bert were to say '200 degrees per second', Ernie would be well informed. On the other hand, if Bert were to respond 'the rotation frequency is 3.49', we would all agree that Ernie would not know the rotation frequency. Nor, would a response of '3.49 per second' be useful to Ernie, any more than a response of '200 per second'. In order to convey useful information, Bert must tell Ernie the units in which he is reporting the rotation frequency, including the so-called dimensionless units of cycles or radians or degrees. The current formulation of the SI specifically allows the units 'radian' or 'cycle' to be replaced by the dimensionless unit 'one', and it allows both radians per second and cycles per second (Hz) to be replaced with inverse seconds. Clearly, if Bert had followed this prescription, allowed by the current SI, he would have left Ernie in the dark about the rotation frequency.

If Bert had given an uninformative response about the rotation rate, Ernie might have asked 'what is the concentration of oxygen in the air you're breathing?' Bert could respond 'about 10^{25} atoms m^{-3}' or '5×10^{24} molecules m^{-3}'. These are clear answers. A factor-of-two ambiguity would arise if he had not specified the entity being counted; in fact, the current SI says that 'atoms' or 'molecules' are dimensionless units that should be set equal to 'one'. If Bert had said '5×10^{24} m^{-3}', Ernie might have interpreted that as being the atomic density and wonder if oxygen deprivation had compromised his friend's mental acuity.

Such situations allowed by ambiguous units are untenable, which is one of the main points of this paper. Fixing the problem is not going to be easy, as evidenced by the fact that it has persisted for so many years after the institution of the SI in 1960. This situation has led to such problematic pronouncements as 'the radian and steradian are special names for the number one ...' [1]. One starting point is to recognize that replacing radians or cycles or similar dimensionless units by 'one' leads to trouble, and replacing molecules by 'one' in expressions for molecular concentration may also lead to trouble. These and similar arguments are made explicit below, as are our suggestions for a revision to the SI that goes a long way toward solving the problem[1].

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[1] The hypothetical conversation in this section is not meant to suggest that there actually was such a conversation between Albert Einstein and Ernest Rutherford.

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Updates to the International System of Units (SI) brochure (8th edition)

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Publication History

Published Online: 2014-11-18

In June 2014, the Consultative Committee for Units (CCU) of the Bureau International des Poids et Mesures (BIPM) released a supplement to the current edition of the SI brochure (www.bipm.org/en/si/si_brochure), which lists the most significant changes to be made to the 8th edition, published in 2006. The changes result from recommendations made by the CCU at its 19th (2009), 20th (2010) ,and 21st (2013) meetings and which were approved by the CIPM at its 103rd meeting in March 2014.

The intention was not to comprehensively review the full text of the brochure; instead, the most significant items were updated to bring them into line with the recent recommendations and at the same time references to other documents were updated. The supplement includes the new definition of the astronomical unit for length adopted by the XXVIII General Assembly of the International Astronomical Union (IAU) in 2012.

The updates listed in "Supplement 2014" have been included in the HTML version of the SI brochure (8th edition) which is available on the BIPM website, and an insert will be included in the remaining printed copies of the brochure.

www.bipm.org/utils/common/pdf/si_supplement_2014.pdf

www.bipm.org/en/si/si_brochure/

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Paul's Column on MIC

The Avogadro number is an integer multiple of the number "1"

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Published online: 24 January 2015

Without Abstract

Disclaimer The author is a member of the Joint Committee on Guides for Metrology (JCGM), Working Group 2 (VIM). The opinions expressed in this Column do not necessarily represent the view of the Working Group or of ACQUAL.

In early civilizations, the question "how much is there?" could be related to a number of cattle, soldiers, days, or denarii (a denarius is a Roman silver coin current 187 B.C.–274 A.D.). It gave rise to the development of a numbering system 1, 2, 3, … enabling to quantitatively express a number of things (generically called entities). Counting them by means of numbers is a very old way of obtaining an answer to the question "how much is there?" It also gave rise to special names for defined numbers such as a dozen (for 12) or a gross (for 144, i.e. 12 dozens). However, counting of things is only related to discrete entities since a fraction-of-entity is not meaningful nor even possible (that would destroy the very concept of discrete entity). The unit for measuring such numbers is quite simple: it is (the natural number) 1. Contrary to the requirement that results of measurements are expressed as a number times a stated unit [*1*], the unit is not written after the number in the case of counting because adding "times 1" after a number, is somewhat superfluous. [Numbers are termed "natural" when fractions are not possible and "real" when fractions are possible such as in 17.52 m]

Numbers used in counting are independent of the nature of the entities. The quantity involved is "number of entities" which "can be regarded as a base quantity in any system of units" according to entry 1.4 NOTE 3 in [*2*]. Their measurement unit is one, symbol 1 "which can be regarded as a base unit in any system of units" according to entry 1.10 NOTE 3 in [*2*]. According to another usage, the term used to designate a quantity ("number of entities") must not be used in naming the unit.

Twenty-first century analytical sciences make it possible that (very) small numbers of atoms and molecules can be counted in, e.g. a measurement of a few hundreds of atoms

or molecules by isotope dilution mass spectrometry. Single electron tunnelling has been achieved and opens the possibility of counting single electrons. The number of particles in a specified volume of laboratory air in "clean" laboratories" for (ultra-) trace analysis, serves to express the quality of the laboratory air is, e.g. "class 100" when the air contains 100 or less than 100 particles of less than 0.5 μm per cubic foot (a US standard in the field). The simplest and most convenient unit to express such measurement results is (the natural number) 1. As the number of entities measured in analytical work becomes larger, counting of discrete entities comes with a significant measurement uncertainty (a rate of 10^5 s^{-1} can be achieved by modern ion counters with an acceptably small counting uncertainty such as (10 5) − − − − √ /10 5 =0.0031) .

For measuring or working with extremely large numbers such as of the order of 10^{23}, a unit consisting of an extremely large number (of the order of 6×10^{23}) was coined for use in the equations of statistical thermodynamics (nineteenth/twentieth century) where packages of extremely large numbers of atoms or molecules in gases are involved. It was coined the "mole". A value for this unit, formulated as a natural number, i.e. a multiple of 1 (and therefore an integer number, but that was not—yet—relevant) was not realistic as the idea of "single atom or molecule counting" was unimaginable in those days. Therefore, the large number in a unit "mole" was not defined as a fixed number of entities (multiple of 1) contained in one "mole", but defined as "as many entities as there are ^{12}C atoms in 12 g of ^{12}C", still the definition of the mole today. This reference is usable for all kinds of entities. It is also metrologically appropriate to serve as "reference" in the meaning of entry 2.41 NOTE 1 in [2] for establishing metrological traceability, the conditio sine qua non for achieving "comparability of measurement results" (entry 2.46 in [2]) for the same kind of quantity. No need to know the "absolute" number of entities, taking a "package" is enough. An example of where large numbers of entities (e.g. OH^- ions in a solution) become measurable when they are compared to another equally large number of other entities (e.g. H^+ ions)—defined as unit—is titration. When "equivalence" between number of OH^- and H^+ ions is attained (as indicated by a colour change of the solution), the comparison of the very large unknown number to the very large known number leads to the unknown becoming a known thus being a "measurement". The number of entities involved is of the order of 10^{18} in a mL of solution containing a concentration of solute of about 2 μmol/mL. The operation "measurement" requires the concept of an appropriate unit "mole" as described above.

The possibility was created to think and work with a unit consisting of packages of entities of the same size. The unit was even termed a "base unit". It served well the intended use.

The question now arises: "of which quantity is the 1971 mol the unit?"

The answer to the question was coined for the 1971 definition of the base unit "mole": it is the base quantity "amount of substance". The problem was—and still is—that this base quantity was not a current concept in the minds and was not described before the coining of its unit. Thus, parlance developed in the laboratory practice to call it the "quantity of which the mole is the unit", which is not a logical application of the same rule as applied for all other quantities. A base quantity is either well known or conceived and described first, then a measurement unit is allocated to it [1]. For instance, we first conceived or simply understood "mass", then defined a unit for it: the kilogram. We first conceived or

simply understood "time", then defined a unit for it: the second. We first conceived or simply understood "electric current", then defined a unit for it: the Ampère.
Implementing the thinking in modern analytical science in terms of discrete atoms and molecules, the unit mole, defined as indicated above, can be replaced by a unit for large numbers which is defined as a multiple of the unit 1. Such a newly defined mole can equally serve as common reference for metrological traceability (entry 2.41 NOTE 1 in [2]) of measurement results, fulfilling the criterion imposed by the definition of metrological traceability and, hence, making these results mutually comparable, the goal of all measurement. The number of entities can be a number such as 10^{23}, the order of magnitude needed. But for reasons of continuity, it should be chosen as closely as possible to $6.022\ 14X\times10^{23}$. That is the Avogadro number.
It follows that the Avogadro number is a multiple of 1, thus providing a simple common reference, i.e. the definition of a simple common measurement unit (entry 2.41 NOTE 1 in [2]) for the analyst to make all results expressed in that unit, comparable to each other. Even more important is the fact that this concept of a unit for analytical measurements is easily teachable from high school to undergraduate and graduate teaching levels.
As usual, any comment, question, or amendment is welcome, preferably as a contribution to the Discussion Forum of this Journal.

References

1. Le Système International d'Unités SI—The International System of Units SI, edition 8, section 1.1 ISBN 92-822-2213-6, BIPM, 2006 at www.bipm.org/utils/common/pdf/si_brochure_8_en.pdf

2. BIPM, IEC, IFCC, ILAC, IUPAC, IUPAP, ISO, OIML (JCGM 200:2008/2012) International vocabulary of metrology—Basic and general concepts and associated terms (VIM), 3rd edn, at http://www.bipm.org/vim

NTS PLANNING

NTS Planning

- BOSTON UPDATE
- VOLUNTEERING OPPS
- NEW BUSINESS

Boston ACS Meeting

From: May, Willie E. Dr. [mailto:willie.may@nist.gov]
Sent: Wednesday, January 28, 2015 11:29 AM
To: PFRusch@aol.com
Cc: alfornow@sbcglobal.net; Fenske, Gerald Jr.
Subject: RE: Boston ACS Meeting

Thanks Pete.

As it now turns out, CCQM will not be meeting in Boston, but rather will be offering an all-day Symposium.

CCQM Symposium at American Chemical Society (ACS) National Meeting, Boston, Massachusetts, August 16-20, 2015

Session I

- The Importance and Role of the Mole and the Kilogram in Chemical and Biological Measurements

- CIPM Activities to Redefine the Mole and Kilogram

Session II

- The CCQM and its Activities to Assess and Improve the Equivalence of National Standards for Chemical and Biological Measurements

From: PFRusch@aol.com [mailto:PFRusch@aol.com]
Sent: Wednesday, January 28, 2015 11:13 AM
To: May, Willie E. Dr.
Cc: alfornow@sbcglobal.net; gfenske@cas.org
Subject: Boston ACS Meeting

Dear Willie:

I have been reading the ACS program for the Boston meeting in C&E News of 19 January 2015 and have a suggestion.

As the CCQM and ACS will be meeting jointly in Boston, there are some symposia in the ACS Analytical Division program that could attract and welcome participation by CCQM participants. They are:

- Challenges in Bioanalytical Chemistry, Chair: J. Wang; e-mail jwang34@albany.edu; and
- Improving/Validating Analytical Laboratory Performance: The Role of Proficiency Testing; Chairs:M. Latko and A. Oler; respective e-mails: mlatko@aiha.org & aoler@aiha.org.

Abstracts are due to the Chairs by 16 March 2015.

Having attended the CCQM meeting in April last year, these seem to me to be relevant topics that overlap with the mission of CCQM. CCQM participation in these symposia would offer the ACS and CCQM further opportunity to advance cooperation.

Best Regards,

Pete

Peter F. Rusch
Electronic Information Consultant
Tel/fax +650-961-8120
e-mail: PFRusch@aol.com

Ladies and Gentlemen of the NTS-

I have two opportunities, looking for realizers. If you are interested in volunteering for either of these two, or just want to know more about them, contact me, or the person associated with each of these projects, as shown below.

OPPORTUNITY #1:

Become a member (voting or consulting) on the IEEE SCC14 standards coordinating committee. I am currently a members of this group, and they (we?) are looking for additional members with expertise in the standards and units areas.

Learn more about the SCC 14: at http://standards.ieee.org/about/sasb/scc.html

Contact person:
Howard Ressel
Project Design Engineer
NYSDOT
1530 Jefferson Road
Rochester, NY 14623
585 272-3372

Opportunity #2

The United States National Committee for IUPAC is pleased to announce that applications are now being accepted for the 2015 IUPAC Young Observers Program. Information about this travel award is below. Could you please share it with the members of the NTS and any other group or individual you think might be interested in the program?

For the purposes of this program, "young" has the statutory definition of "under 45".

Learn more about this program at:
http://sites.nationalacademies.org/PGA/biso/IUPAC/PGA_049284

Contact person:
Kathryn Hughes, Ph.D.
Senior Program Officer
Board on Chemical Sciences and Technology National Academy of Sciences
500 Fifth St., NW
Washington, DC 20001
Phone: 202-334-3090
Fax: 202-334-1961

Albert Censullo, Ph.D.
Chair, ACS Committee on Nomenclature, Terminology, and Symbols

ACS Information Update
Denver, March 2015

- Nanotechnology Symposia – Diane Grob Schmidt

- ACS Strategic Plan for 2015
  Nomenclature, Terminology, and Symbols Committee role

- ACS Governing Documents (Bulletin 5)
  - no changes for 2014

- National Awards Canvassing and Selection Committees Information

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- ACS Fellows Program 2015

- ACS Council Issues

- The Poisoner's Guide to Communicating Chemistry
  Deborah Blum

American Chemical Society

1155 SIXTEENTH STREET, N.W.
WASHINGTON, D.C. 20036
Phone 202-872-4461
Fax 202-872-6338

OFFICE OF THE PRESIDENT

Diane Grob Schmidt, Ph.D.
President-Elect, 2014
President, 2015
Immediate Past President, 2016

February 20, 2015

Dear Staff Liaisons,

I am writing to ask if you would include my Presidential symposia ad in your agenda book in conjunction with the 249th ACS National Meeting in Denver, CO. You will see in the advertisement that many ACS committees and divisions – as well as external societies – are co-sponsors of the various Presidential symposia.

For the past 15 years, ACS has conducted scientific symposia on nanotechnology research at national and regional meetings. This symposium will highlight the state of research and product development relating to nanomaterial science through a Presidential Symposium beginning Sunday March 22, 2015 and concluding Monday the 23rd.

This broad technical symposium, *Nanotechnology: Delivering on the Promise* will feature three half-day sessions with 16 senior-level speakers from industry, academe, and government. It will focus on the state of various aspects of research and development; opportunities and challenges for health, safety, and the environment; and meeting the challenges of moving the research products into a thriving US marketplace.

My other symposium focusing on nanotechnology is *DOE Nanoscience Research Centers: National Resources for the Nanoscience Community* on Tuesday, March 24 from 8:30-11:30 a.m. This symposium will feature the five heads of chemistry at U.S. national laboratories. This is the first symposium of its type to highlight these speakers collectively.

Along with my nanotechnology symposia, I am also recommending several others, including *Chemistry Without Borders: The Transnational Practice of Chemistry and Allied Sciences and Engineering* on Sunday, March 22 from 8:00 a.m.-12:00 p.m.

Thank you for considering this special request.

Sincerely,

Diane Grob Schmidt

Diane Grob Schmidt, Ph.D.
2015 ACS President
American Chemical Society

PRESIDENTIAL SYMPOSIA AND EVENTS

Sponsored and Recommended by the ACS President

Photo: Peter Cutts Photography

Diane Grob Schmidt, Ph.D.
ACS President

Saturday, March 21, 2015

10:00 AM-2:00 PM

Presidential Outreach Event: Exploring Our World Through Chemistry

(Cosponsored by CCA)

Denver Zoo, 2300 Steele Street

Sunday, March 22, 2015

8:00 AM-12:00 PM

Chemistry Without Borders: The Transnational Practice of Chemistry and Allied Sciences and Engineering

(Cosponsored by IAC, COMSCI, BMGT & SOCED)

Colorado Convention Center, Mile High Ballroom 3A (Lower Level)

Sunday, March 22, 2015

1:30-5:30 PM

Monday, March 23, 2015

8:30 AM-4:45 PM

Nanotechnology: Delivering on the Promise

(Cosponsored by the following ACS Divisions and Committees and other scientific societies AGFD, AGRO, ANYL, CARB, CHAS, COLL, ENFL, HIST, I&EC, PMSE, POLY, SCHB, MPPG, CA, CCS, CCPA, COMSCI, DAC, IAC, SOCED; American Institute of Chemical Engineers, Gordon Research Conferences, Materials Research Society & National Academy of Engineering)

Colorado Convention Center, Mile High Ballroom 3A (Lower Level)

Tuesday, March 24, 2015

8:30-11:30 AM

DOE Nanoscience Research Centers: National Resources for the Nanoscience Community

(Cosponsored ANYL, ENFL, CCPA, CEI & MPPG)

Colorado Convention Center, Rooms 506-507 (Street Level)

OTHER SYMPOSIA RECOMMENDED BY THE PRESIDENT

Excellence in Graduate Polymer Research

(Sponsored by POLY and cosponsored by PRES)

Sheraton Denver Downtown Hotel

GSSPC: Designed by Nature, Developed by Science: Interdisciplinary Perspectives on Biocatalysis

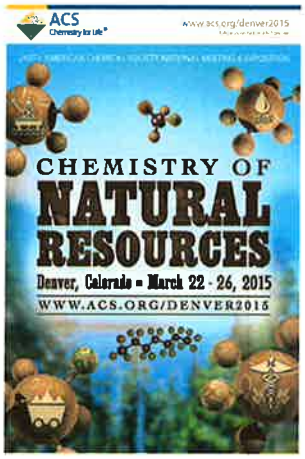
(Sponsored by CHED and cosponsored by PRES, ANYL, BIOL, CATL, ENVR, I&EC, MEDI, & ORGN)

Sheraton Denver Downtown Hotel

Department, University and National Models for Faculty Development to Support Adoption of Evidence-Based Teaching

(Sponsored by CHED and cosponsored by PRES, INOR & ORGN)

Sheraton Denver Downtown Hotel



The Interface of Chemical and Biological Sciences International Disarmament Efforts

(Sponsored by IAC and cosponsored by PRES, ANYL, CHAL & CPRC)

Hyatt Regency Denver at Colorado Convention Center

Transitioning between Academic Research into Practical Use: Solar-Energy and Advanced Materials?

(Sponsored by COMSCI and cosponsored by PRES & MPPG)

Colorado Convention Center

Madeleine Jacobs
ACS Executive Director & CEO

The *ACS Strategic Plan for 2015 and Beyond* has been approved by the Board of Directors and is available online.

It continues to highlight the Society's roadmap of how we will advance toward a future where our vision of "Improving people's lives through the transforming power of chemistry" is a reality. This release of the plan maintains our Vision, Mission, and Core Values, as in past years, which continues to provide the foundation upon which our four continuing Goals are built. Our all-new Objectives in support of the Goals allow us to effectively address the Challenges the chemistry enterprise faces, while taking advantage of the available Opportunities. Please take a few minutes to review the full plan at http://strategy.acs.org/.

Supported by specific, proprietary targets, each of the Objectives are monitored by the ACS Board of Directors, as we make tangible progress toward our Goals. Please take a look at the Objectives that most relate to your own work.

Each of the four Goals on the plan web site also features Ongoing Activities, Recent Progress, and ways in which members can Get Involved in the ACS programs that will make our Goals a reality.

The Society will continue its focus on maintaining a strong and sustainable organization by marshaling our unique resources to achieve the following four Goals:

1. Be the most authoritative, comprehensive, and indispensable provider of chemistry-related information.
2. Empower an inclusive community of members with networks, opportunities, resources, and skills to thrive in the global economy.
3. Foster the development of the most innovative, relevant and effective chemistry education in the world.
4. Communicate chemistry's vital role in addressing the world's challenges to the public and policymakers.

As we continue our exciting work, think about how your individual objectives, and those guiding your unit, are in alignment with the overall direction of the Society. I encourage you to discuss the ACS strategy with your managers and other colleagues.

If you have suggestions or ideas about the plan, please email them to strategicplan@acs.org. Your partnership and efforts enable ACS to excel and fulfill our Vision of "Improving people's lives through the transforming power of chemistry."

Thank you!
Madeleine Jacobs

Dear ACS Committee Chairs and Staff Liaisons of Council-related committees:
Elected, Standing, Other, and Joint Board/Council Committees
(blind copies also sent to Chairs and Staff Liaisons of Board-related committees for information only, and other staff),

During 2014, there were no changes to the *ACS Governing Documents* (**Bulletin 5)**, which includes the Constitution, Bylaws, Board Regulations, committee information, etc. Therefore, in our continuing efforts to be sustainable, we did not print Bulletin 5 this year.

The web version (www.acs.org/bulletin5), for which I've attached a PDF for your convenience, continues to be the authoritative version. We encourage you and your committees to use the PDF/web version, which includes hyperlinks in the Table of Contents and bookmarks for easy navigation. You can search for words (control-f), copy (control-c) and paste (control-v) large portions or just excerpts into Word documents, change the font and font size, and print, email, etc. of only what you want. If you received a 2014 edition, please continue to use it.

For all committees, especially those that have been assigned petition responsibility, I ask Staff Liaisons to send the PDF and link to your committee members and associates or forward this email to them. If you or your committees refer to Bulletin 5 frequently, please save the PDF of Bulletin 5 on your computer; so that you can access it when you don't have internet access, such as in committee meeting rooms.

Let either Jim Carver, C&B Chair, or me know if you have any questions or comments.

Thank you kindly. Regards,
Barbara

Barbara F. Polansky, PMP
Staff Liaison, Committee on Constitution and Bylaws (C&B)
and Senior Program Manager, Trademarks and Bylaws
202-872-4071 or 800-227-5558, x-4071
www.acs.org/bulletin5

ACS
Chemistry for Life®

October 14, 2014

Dr. Albert C. Censullo
Chair
Committee on Nomenclature, Terminology, and Symbols
1595 Cordova Drive
San Luis Obispo, CA 93405-4731

Dear Dr. Censullo:

As an ACS Committee Chair, I believe your knowledge of your colleagues in the chemistry community could be vital to the ACS National Awards Program. Your help would be greatly appreciated in identifying experts for consideration for appointment by the President-Elect to the 2016-2017 **National Awards Canvassing and Selection Committees**. In drawing up your lists, I ask you to consider nominating respected scientists, past chairs of your committee, and colleagues. Please consider people who will be open to entertaining nominations from chemists and chemical engineers, as well as people working at the interfaces of other sciences. In addition, ACS is committed to recognizing excellence in people who represent groups not commonly identified as recipients of ACS awards such as women and minorities, chemists from industry and the national laboratories, and faculty members at universities not routinely noted in the award recipient pool.

As always, I also invite you to suggest or nominate individuals by November 1, 2014, for any of the ACS National Awards at www.nominate.acs.org.

Please complete the attached form and return it by **Tuesday, November 11**, to Felicia Dixon at **f_dixon@acs.org** or fax them to 202-776-8008. If you have any questions, please contact Ms. Dixon at 202-872-6283. For information about the ACS National Awards, please visit www.acs.org/nationalawards.

Thank you for your help with this matter. It is vital to the chemical community that the ACS award recipients continue to be of the highest caliber.

With warm regards,

Valerie J. Kuck

Valerie J. Kuck
Chair, ACS Board Committee on Grants & Awards

Enclosure

American Chemical Society
1155 Sixteenth Street, N.W. Washington, D.C. 20036 **T** [202] 872-6283 **F** [202] 776-8008 www.acs.org/awards

ACS National Awards
2016-2017
Suggestions of Individuals for Appointment to ACS National Awards Committees

Individuals that should be considered for Canvassing or Award Selection Committee Appointment

Name of Individual	Contact E-mail	Contact Telephone	Area of Expertise	Gender	Ethnicity	Employer and Location	Suggested Award Appointment

Return completed form to awards@acs.org or fax to 202-776-8008 by Tuesday, November 11, 2014

Thank you.

ACS
Chemistry for Life™

ACS Fellows Program 2015

The American Chemical Society (ACS) Fellows Program recognizes and honors members of the ACS for their outstanding achievements in and contributions to the science and the profession **and** for their equally exemplary service to the Society.

ELIGIBILITY

- Nominees for ACS Fellows must be current members (including retired and emeritus members) in good standing of the American Chemical Society. Former members or deceased members will not be considered as nominees for ACS Fellows.
- Current members of the Fellows Selection Committee, Fellows Oversight Committee, ACS Board of Directors, and current ACS staff are not eligible to be nominees, or primary or secondary nominators.
- The selection of ACS Fellows is based on: (1) Excellence and leadership that have a lasting beneficial impact in science, the profession, education, and/or management; **and** (2) Volunteer service in the ACS community resulting in significant enhancements to ACS programs, products, or services.
- There must be documented evidence of exceptional accomplishments, professional attainment, and impact in **both** of the above two areas.

NOMINATIONS

- Nominations for ACS Fellows are solicited from the following groups:
  - ACS National Committees – Each Committee may nominate one nominee.
  - Technical Divisions – Each Division may nominate up to two times the number of Councilors from the Division. Nominees must be current members of the Division.
  - Local Sections – Each Local Section may nominate up to the number of Councilors from the Local Section. Nominees must be current members of the Local Section.
  - Individual ACS Members – Each individual ACS member in good standing may serve as the primary nominator for only one nominee.
- Self-nominations are not accepted.
- Each nomination requires a primary nominator and two secondary nominators, all of whom must be current ACS members in good standing and provide letters of recommendation. The Primary Nominator is responsible for submitting the nomination.
- Detailed guidelines and instructions for submitting nominations will be available at www.acs.org/fellows.
- 2015 nominations will only be accepted online at https://www.nominatefellow.acs.org during the period February 1 – April 1, 2015 [11:59 PDT].

American Chemical Society
1155 Sixteenth Street, N.W. Washington, D.C. 20036 **T** 202-872-4431 **F** 202-776-8003 fellows@acs.org

This email is to let you know that the ACS Fellows Program is now accepting nominations for 2015 Fellows. The ACS Fellows Program recognizes members of ACS for excellence and leadership in both of two areas: (1) the science, profession, education, and/or management and (2) volunteer service in the ACS community. The nomination submission deadline is **Wednesday, April 1, 2015.**

Committee Eligibility
Each ACS National Committee may submit one nomination. The nominee can be a current or former committee member, committee associate, or consultant to the committee. The Committee Chair must be the primary nominator or one of the secondary nominators **unless** he/she is a current member of the Fellows Selection Committee, the Fellows Oversight Committee, or the ACS Board of Directors, or unless he/she is the Committee's nominee. In such circumstances, the nomination must be delegated entirely to another member of the Committee and the Chair must attest that the individual is indeed being nominated on behalf of the Committee. If the Chair is the nominee, then the attestation must be supplied by another member of the Committee. If all members of the Committee belong to one of the groups not eligible to participate in the Program, the Committee must recuse itself from the nomination process entirely.

Nominees and primary and secondary nominators must be current members (including retired and emeritus members) in good standing of the American Chemical Society. However, current members of the Fellows Selection Committee, Fellows Oversight Committee, ACS Board of Directors, and current ACS staff are not eligible to be nominees or primary or secondary nominators.

How to Submit a Nomination
To submit a nomination, go to www.nominatefellow.acs.org. This URL takes you to the online nomination system, which fully integrates with the ACS membership database. There are several resource documents to inform and facilitate the nomination process, all of which are linked from www.acs.org/fellows: (1) *2015 ACS Fellows Program Guidelines*—detailed information on the program purpose, criteria, nominations, and selection; (2) *2015 ACS Fellows Nomination Checklist*—information/documents needed for a complete nomination submission; and (3) *2015 ACS Fellows Online Nomination System Instructions*—instructions/screenshots to navigate the online nomination system.

I look forward to your assistance in identifying and honoring those of our members who have outstanding contributions and achievements resulting in lasting beneficial impact on the science/profession and significant enhancements to ACS programs, products, or services. Last year many Committees submitted nominations, and we hope that even more will participate this year. I also encourage you to invite your friends and colleagues to submit individual nominations. I've attached a one-pager for 2015 nominations, if you'd like to include information in your committee communications or meeting agenda book.

If you have questions, please email us at fellows@acs.org.

Thank you.

Neil D. Jespersen, Ph.D., ACSF
Chair, Fellows Oversight Committee

Council Issues

- Selecting PE Candidates
- 2016 Membership Dues
- Recommendation for continuation of ComSci and Ethics
- Petitions to charter two new International Chemical Sciences Chapters: India & Taiwan
- Petitions for consideration: Member Expulsion; Preferential Voting

ACS
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www.acs.org/denver2015

JOIN THE
ACS BOARD OF DIRECTORS OPEN MEETING

Guest Speaker: **Deborah Blum**

2015 Grady Stack Award Recipient

Helen Firstbrook Franklin Professor
School of Journalism and Mass Communication
University of Wisconsin-Madison

Sunday, March 22, 2015
Noon – 1:00 PM
Four Seasons Ballroom 4 (Lower Level)
Colorado Convention Center

The Poisoner's Guide to Communicating Chemistry

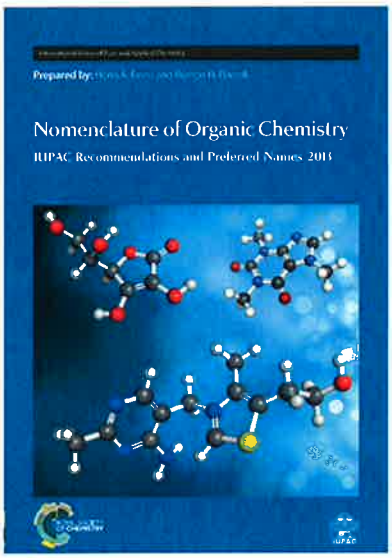
Join the ACS Board of Directors at its Regular Session as they host lunchtime speaker Deborah Blum. Deborah is an American journalist, a columnist for the *New York Times*, a professor of journalism at the University of Wisconsin-Madison, and a blogger for *Wired*. She is also the author of several books including ***The Poisoner's Handbook***. She is a much sought out speaker and has appeared at several very well-attended ACS symposia focused on communicating chemistry/science to the public.

Deborah will be receiving the 2015 Grady-Stack Award at the ACS National Meeting in Denver, March 2015, for her achievements in public outreach, engagement and communications.

Sandwiches available for first 200 attendees.

New Edition of the "IUPAC Blue Book" Nomenclature of Organic Chemistry—IUPAC Recommendations and Preferred Names 2013

Prepared for publication by Henri A. Favre and Warren H. Powell
Royal Society of Chemistry, Cambridge, UK, December 2013, ISBN: 978-0-85404-182-4



Thirty-four years after the publication of the last full edition of the *Nomenclature of Organic Chemistry* known as the "IUPAC Blue Book," in 1979, and 20 years after the release of an abridged version also known as the *Guide to IUPAC Nomenclature of Organic Compounds*, in 1993, IUPAC has recently published a comprehensive and revised edition of this key reference.

The ever-increasing number and complexity of known compounds have resulted in a major extension of the Blue Book. New sections cover the naming of new classes of compounds, such as fullerenes, and new nomenclature systems, such as phane. At the same time it became necessary to make chemical nomenclature more systematic in order to increase the number of names with an explicit relationship to the structure of the compound, and so that the reader or listener can more easily and unambiguously identify a chemical species and deduce its structure from the name. The book also includes a range of traditional names, semi-systematic or trivial, retained for a core group of common compounds but to a lesser extent than in the previous edition. One of the most important aspects of this new edition is the inclusion of preferred IUPAC names or PINs. A PIN is a single name selected for a compound from several acceptable alternative unambiguous names.

The need for PINs has long been recognized and its implementation started some 20 years ago. It this respect, the recommendations consolidated and presented in the new Blue Book are valuable both for reference and education purpose.

Over its lengthy preparation, the book was submitted twice for public review by the scientific community, first in 2004 and than again in 2010. In the continuous effort of improving the accuracy of such large book—some 1600 pages—a task group of IUPAC is already compiling typos and errors that inevitably have appeared in the print release. A list of errata is available at www.chem.qmul.ac.uk/iupac/bibliog/BBerrors.html and will also be shared via the publisher's website. Everyone's input can be submitted by email to BlueBook@iupac.org.

Despite these shortcomings, the new Blue Book will be an invaluable source of information for chemists of all fields and the definitive guide for scientists working in all areas involving chemical nomenclature, from academia to industry, for scientific publishers of books, journals, and databases, or even for organizations requiring internationally approved nomenclature in a legal or regulatory environment.

The book is dedicated to the memory of Henry Favre; while a key contributor and main author, Professor Favre passed away in July 2013 during the final stage of the manuscript preparations.

www.rsc.org/shop/books/2013/9780854041824.asp

Corrigendum

In the review of the book titled *Early Days of X-ray Crystallography* by A. Authier, the reviewer David Viterbo wrote: "The most relevant omission is represented by the three cursory lines over the 'prodigious development of the applications of X-ray diffraction,' which deserved some more attention, considering the number of Nobel awards given for such studies" (*Chem Int.* May-June 2014, p. 23).

The reviewer reported an omission and the corrected sentence should read: "The most relevant omission is represented by the three cursory lines over the 'prodigious development of the applications of X-ray diffraction to the study of biological substances,' that deserved some more attention considering the number of Nobel awards given for such studies."

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Download Date | 8/5/14 7:06 AM

Symbols of the Elements, Part III (concluded)*

by Juris Meija

During the 20th century the IUPAC symbols for all known chemical elements gradually became the international standard. With the house all in order, the proposed symbols for all newly discovered elements were now scrutinized more than ever, and the nomenclature was set for elements which have not yet been discovered. This is the story of the 20th century.

The Forbidden Symbols

Most aspects of our culture undergo change. Newspapers change their design, corporations change their logos, and countries even change their flags. Symbols of chemical elements are no exception to this rule of life. The inaugural 1903 International Atomic Weights Report, for example, contains quite a few symbols that are no longer in use. There is A for argon, Rd for radium, Yt for yttrium, Gl for glucinum (beryllium), and Cb for columbium (niobium). In addition, other elements have had their symbols changed over the years. By the late 1950s, argon officially become "Ar" and element symbols finally became standardized.

It has been long accepted that the names of elements should be unique and should not recycle some older names that have felt out of vogue long ago.

Symbol	Previous use	Example reference*
A	argon	CIAAW 1902-1955
An	radon-219 (actinon)	CIAAW 1923
Cb	niobium (columbium)	CIAW 1903-1947
Cp	lutetium (cassiopeium)	used for lutetium in the past
Ct	hafnium (celtium)	CR 1947
Gl	beryllium (glucinium)	CIAAW 1903-1925
Ha	hassium (hahnium)	IUPAC 1994
Io	thorium-230 (ionium)	CIAAW 1923
J	iodine	CIAAW 1925, CIAAW 1902
Jl	dubnium (joliotium)	IUPAC 1994
Mv	mendelevium	CR 1955
Nt	radon (niton)	CIAAW 1912-1922
Rd	radium	CIAAW 1903, 1906-1907
Sa	samarium	CIAAW 1906-1922
Tn	radon-220 (thoron)	CIAAW 1923
Tu	tungsten, thulium	CR 1947, CIAAW 1902
X	xenon	CIAAW 1902
Yt	yttrium	CIAAW 1903-1907, 1910-1922

*Table 1. Symbols of elements that are no longer used by IUPAC. *CIAAW: International Atomic Weight Tables, CR: Comptes Rendus IUPAC. CIAAW-1902 refers to the 1902 German edition of the first CIAAW table preceding the 1903 Inaugural CIAAW report.*

Arguably, the same logic should also apply to symbols of elements.[1] This kind of convention, however, cannot extend too deep into the past because far too many letter combinations were indiscriminately used during the 19th century textbooks. While it is indeed impractical to restrict our choice of new symbols by lingering too deep into the recycle bin of history, it seems fair that any overlap between the International Atomic Weight Tables dating from 1902 and the subsequent IUPAC recommendations is off limits. Table 1 lists the symbols of elements once used in the International Atomic Weight Tables, which are no longer used by IUPAC and therefore are unlikely to enter the periodic table ever again.

Interestingly enough, because all symbols of chemical elements are now formed from the letters in their English names, and because all symbols have to be unique, this may result in a situation when the inability to form a proper symbol does pre-empt the choice of a suitable name of an element. For example, it would be impossible to name a future element after the Estonian capital Tallin (tallinium) because no unique two-letter symbol starting with "T" can be formed. This is because all letter combinations—Ta, Tl, Ti, Tn, Tu, and Tm—are either currently used by IUPAC or have been used in the past as in the case of Tu which was used for thulium by IUPAC in the 1940s, and Tn which was used for an isotope of radon in the roaring twenties. Although this obscure roadblock is not likely to be encountered in naming of some future element, it nevertheless shows the intricate kinship between the symbols and the names of elements.

Brave New Elements

It is in the human nature to seek behind what is known in order to discover new treasure, new worlds, or new chemical elements. The question is, how do we talk about the elements yet to be discovered? What name and symbol shall be given to elements that do not yet exist? Mendeleev had an idea: "So as to avoid introducing new names for the unknown elements into science, I shall designate them by the name of the nearest lower analog of the odd or even elements in the same group, and place in front of this name a Sanskrit numeral (eka, dvi, tri, tschatour, etc.). The unknown elements of the first group will be called eka-cesium (Ec = 75), dvi-cesium (Dc = 220), etc. If niobium, for example, were not known, we would call it eka-vanadium."[2]

Although Mendeleev's nomenclature was good for Sanskrit lovers, and is still used informally, it relies on

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Numeral	Prefix	Symbol
0	nil	n
1	un	u
2	b(i)	b
3	tr(i)	t
4	quad	q
5	pen(t)	p
6	hex	h
7	sep(t)	s
8	oc(t)	o
9	en(n)	e

Table 2. IUPAC systematic nomenclature for naming newly discovered or not yet discovered elements. Letters in parenthesis are omitted if they are followed by a repeating letter (eleison rule). For example, the element with atomic number 902, or simply the element 902, is named ennilbium, and not ennnilbiium.

the periodic table. If elements are rearranged in the periodic table, their temporary names change thus avoiding unnecessary confusion. A case in point is rhenium which was dubbed tri-manganese by Mendeleev, but now appears only two places below manganese. Also, protactinium used to be eka-tantalum before it was properly placed among the actinides.

In 1979, IUPAC adopted a naming system of all future elements which relies on their atomic numbers.[3] In this system, the name of a newly discovered (or undiscovered) element is formed by stringing prefixes of Greek and Latin words of the numerals which form the atomic number of the element (see Table 2). The portmanteau name is always followed by the suffix "-ium". The symbol of an element is formed by stringing together the first letters of the corresponding prefixes. The systematic nomenclature is straightforward. For example, until a proper name will be adopted (if ever), the element with atomic number 2176 is officially called biunsepthexium (symbol Bush), which literally means "the 2176th" in the made-up hybrid list of scientific Latin and Greek.

One would never guess, but chemical nomenclature can indeed be amusing. As the previous example hinted, there is plenty of room for play with the IUPAC nomenclature.[4] Does the Roman pontiff have his personal chemical element (yes, the element 5859)? Which elementary particle is also a symbol of an element (Photon)? We will end the series on element symbols on this note.

**For Part I see* Chem Int *Jan-Feb 2014, p. 20-21, and for Part II, see* Chem Int *Mar-Apr 2014, p. 18-20*

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On the Naming and Symbols for Elements 115 and 112

by Eric Scerri

On 27 August 2013 it was announced that scientists from Lund in Sweden had obtained good evidence for the existence of element 115. This event inevitably sets up speculation as to what the element may eventually be named and what its symbol might be. Of course these matters will be adjudicated by the appropriate IUPAC committee and the outcomes will be rapidly disseminated around the world.

In this short communication, I would like to sound a warning about the choice of symbol, in particular, and to mention something that happened over the choice of symbol for element 112, which was named copernicium.

After this element was initially discovered and subsequently approved, the discoverers at the Gesellschaft für Schwerionenforschung (GSI) in Darmstadt, Germany, proposed the symbol Cp. But during the obligatory six-month period of discussion that followed this proposal it was pointed out that Cp had once been used for an element "cassiopeium" which subsequently became known as lutetium. As in the case of any name proposed for an element that is subsequently rejected, any symbol for a rejected element can also never be used again. As a result IUPAC asked the discoverers to choose another symbol, whereupon Cn was proposed and duly ratified.

There is just one further problem. Although nobody seems to have noticed at the time, the symbol Cn had also once been proposed for an element, coronium, whose name and symbol were published in several articles by the English physicist and mathematician

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John Nicholson almost exactly 100 years ago. In an ingenious theory that involved the postulation of several proto-elements, Nicholson rather successfully explained numerous unidentified spectral lines in gaseous nebulae as well as the solar corona. Moreover Nicholson successfully predicted several spectral lines in these two kinds of astronomical bodies. His theory was quickly eclipsed by Bohr's theory of the hydrogen atom and very little of Nicholson was heard of subsequently. It is rather remarkable that he should have achieved the success that he did given that none of his proto-elements such as nebulium or coronium actually exist.

Element names such as mosleyum, which might have made an excellent choice in this the year of the centenary of Moseley's great discovery, have been ruled out on the basis that they referred to elements that were once proposed and then rejected. So let's try to make sure that whatever name and symbol are chosen for element 115 are indeed unique and have never previously been published.

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IUPAC Projects by project no. for start year 2014

2013-029-2-600: Inventory of developments in the field of RNAi-based pesticides and potential needs for international harmonization of regulatory safety requirements

2013-035-1-100: Evaluated Kinetic Data for Atmospheric Chemistry

2013-052-1-024: IUPAC Color Book Data Management

2013-053-1-400: Polymer Education

2013-054-2-300: Healthy life and active ageing - the contribution of functional food ingredients

2013-055-2-024: Increasing IUPAC's Social Media presence

2013-056-1-800: Nomenclature of carbon nanotubes and related substances

2013-057-3-300: Chemistry Beyond Chlorine

2014-001-2-200: Terminology guidelines and database issues for topology representations in coordination networks, metal-organic frameworks and other crystalline materials

2014-002-1-200: Assessment of Stable Isotopic Reference Materials

2014-003-2-800: End-of-line hyphenation of systematic chemical names

2014-006-1-500: Solubility of Non-steroidal Anti-inflammatory Drugs in Both Neat Organic Solvents and Organic Solvent Mixtures

2014-010-1-100: IUPAC Recommendation for the definition, preferred symbol for all transport properties

2014-011-2-700: Medicinal Chemistry in Drug Discovery, India

2014-012-2-500: 100 Volumes of Plenitude - Celebrating the IUPAC-NIST Solubility Data Series

2014-013-1-700: Nanomaterials in Human Health: The Trends and Future

2014-014-1-400: Terminology for modeling and simulation of polymers

2014-016-2-200: Compilation of the variation of the isotopic composition of the elements via crowdsourcing

2014-017-1-700: Piloting NPU-SNOMED CT mapping

2014-018-2-022: Company Associates System Reengineering - Assessment

2014-019-1-700: The emerging problem of Novel Psychoactive Substances

2014-021-1-100: The IUPAC Green Book - Preparation of the 4th revised printing of the 3rd Edition

2014-022-1-700: Highlights in Medicinal Chemistry - Short Course to postgraduate students of the summer school at the Federal University of Rio de Janeiro (UFRJ)

2014-023-2-600: Climate Change: Observed Impacts on Planet Earth, 2nd Edition

2014-024-1-200: Development and Global Dissemination of an IUPAC Interactive Electronic Isotopic Periodic Table and Supporting Resources for the Education Community

2014-027-1-500: IUPAC/CITAC Guide for classification, modeling and quantification of human errors in a chemical analytical laboratory

End-of-line hyphenation of systematic chemical names

What to do at the end of a line?

Because names of chemical compounds can be quite long and often require division at the end of a line, the project aims at formulating a set of recommendations that describe how these names should be meaningfully divided at line breaks. The recommendation should also prohibit division at illogical places. At present, proof reading may consist for a large part of suggesting other ways of how/where to divide chemical names in ways that make sense to a chemist. To avoid this proofreading aspect, the present project also proposes how authors could indicate themselves in their electronic manuscripts where names of chemical compounds can be divided and which hyphens that are part of the systematic name should not be used as end-of-line break.

http://www.iupac.org/project/2014-003-2-800

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