BIPM • Comité consultatif des unités (CCU) • Rapport de la 12e session 1996

Comité consultatif des unités (CCU)

Consultative Committee for Units (CCU)

Rapport de
la 12e session
(avril 1996)
Report of
the 12th Meeting
(April 1996)

Bureau international des poids et mesures

Organisation intergouvernementale de la Convention du Mètre

Comité consultatif des unités ▮ 12e session (avril 1996)
Consultative Committee for Units ▮ 12th Meeting (April 1996)

Comité consultatif des unités
12e session (16-17 avril 1996)

Bureau International des Poids et Mesures

Consultative Committee for Units (CCU)

12th Meeting (April 1996)

Note on the use of the English text

To make its work more widely accessible the Comité International des Poids et Mesures publishes an English version of its reports.
Readers should note that the official record is always that of the French text. This must be used when an authoritative reference is required or when there is doubt about the interpretation of the text.

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THE BIPM AND THE METRE CONVENTION

The Bureau International des Poids et Mesures (BIPM) was set up by the Metre Convention signed in Paris on 20 May 1875 by seventeen States during the final session of the diplomatic Conference of the Metre. This Convention was amended in 1921.

The BIPM has its headquarters near Paris, in the grounds (43 520 m^2) of the Pavillon de Breteuil (Parc de Saint-Cloud) placed at its disposal by the French Government; its upkeep is financed jointly by the Member States of the Metre Convention.

The task of the BIPM is to ensure world-wide unification of physical measurements; its function is thus to:

- establish fundamental standards and scales for the measurement of the principal physical quantities and maintain the international prototypes;
- carry out comparisons of national and international standards;
- ensure the coordination of corresponding measurement techniques;
- carry out and coordinate measurements of the fundamental physical constants relevant to these activities.

The BIPM operates under the exclusive supervision of the Comité International des Poids et Mesures (CIPM) which itself comes under the authority of the Conférence Générale des Poids et Mesures (CGPM) and reports to it on the work accomplished by the BIPM.

Delegates from all Member States of the Metre Convention attend the General Conference which, at present, meets every four years. The function of these meetings is to :

- discuss and initiate the arrangements required to ensure the propagation and improvement of the International System of Units (SI), which is the modern form of the metric system;

- confirm the results of new fundamental metrological determinations and various scientific resolutions of international scope;
- take all major decisions concerning the finance, organization and development of the BIPM.

The CIPM has eighteen members each from a different State: at present, it meets every year. The officers of this committee present an annual report on the administrative and financial position of the BIPM to the Governments of the Member States of the Metre Convention. The principal task of the CIPM is to ensure world-wide uniformity in units of measurement. It does this by direct action or by submitting proposals to the CGPM.

The activities of the BIPM, which in the beginning were limited to measurements of length and mass, and to metrological studies in relation to these quantities, have been extended to standards of measurement of electricity (1927), photometry and radiometry (1937), ionizing radiation (1960) and to time scales (1988). To this end the original laboratories, built in 1876-1878, were enlarged in 1929; new buildings were constructed in 1963-1964 for the ionizing radiation laboratories and in 1984 for the laser work. In 1988 a new building for a library and offices was opened.

Some forty-five physicists and technicians work in the BIPM laboratories. They mainly conduct metrological research, international comparisons of realizations of units and calibrations of standards. An annual report, published in the *Procès-Verbaux des Séances du Comité International des Poids et Mesures*, gives details of the work in progress.

Following the extension of the work entrusted to the BIPM in 1927, the CIPM has set up bodies, known as Consultative Committees, whose function is to provide it with information on matters that it refers to them for study and advice. These Consultative Committees, which may form temporary or permanent working groups to study special topics, are responsible for coordinating the international work carried out in their respective fields and for proposing recommendations to the CIPM concerning units.

The Consultative Committees have common regulations (*BIPM Proc.-Verb. Com. Int. Poids et Mesures*, 1963, **31**, 97). They meet at irregular intervals. The president of each Consultative Committee is designated by the CIPM and is normally a member of the CIPM. The members of the Consultative Committees are metrology laboratories and specialized institutes, agreed by the CIPM, which send delegates of their choice. In addition, there are individual members appointed by the CIPM, and a representative of the BIPM

(Criteria for membership of Consultative Committees, *BIPM Proc.-Verb. Com. Int. Poids et Mesures*, 1996, **64**, 124). At present, there are nine such committees:

1. The Consultative Committee for Electricity and Magnetism (CCEM), new name given in 1997 to the Consultative Committee for Electricity set up in 1927;
2. The Consultative Committee for Photometry and Radiometry (CCPR), new name given in 1971 to the Consultative Committee for Photometry (CCP) set up in 1933 (between 1930 and 1933 the CCE dealt with matters concerning photometry);
3. The Consultative Committee for Thermometry (CCT), set up in 1937;
4. The Consultative Committee for Length (CCL), new name given in 1997 to the Consultative Committee for the Definition of the Metre (CCDM), set up in 1952;
5. The Consultative Committee for Time and Frequency (CCTF), new name given in 1997 to the Consultative Committee for the Definition of the Second (CCDS) set up in 1956;
6. The Consultative Committee for Ionizing Radiation (CCRI), new name given in 1997 to the Consultative Committee for Standards of Ionizing Radiation (CCEMRI) set up in 1958 (in 1969 this committee established four sections: Section I (X and γ rays, electrons), Section II (Measurement of radionuclides), Section III (Neutron measurements), Section IV (α-energy standards); in 1975 this last section was dissolved and Section II was made responsible for its field of activity);
7. The Consultative Committee for Units (CCU), set up in 1964 (this committee replaced the "Commission for the System of Units" set up by the CIPM in 1954);
8. The Consultative Committee for Mass and Related Quantities (CCM), set up in 1980;
9. The Consultative Committee for Amount of Substance (CCQM), set up in 1993.

The proceedings of the General Conference, the CIPM and the Consultative Committees are published by the BIPM in the following series:

- *Comptes Rendus des Séances de la Conférence Générale des Poids et Mesures*;
- *Procès-Verbaux des Séances du Comité International des Poids et Mesures*;
- *Reports of Meetings of Consultative Committees*.

The BIPM also publishes monographs on special metrological subjects and, under the title *Le Système International d'Unités (SI)*, a brochure, periodically up-dated, in which are collected all the decisions and recommendations concerning units.

The collection of the *Travaux et Mémoires du Bureau International des Poids et Mesures* (22 volumes published between 1881 and 1966) and the *Recueil de Travaux du Bureau International des Poids et Mesures* (11 volumes published between 1966 and 1988) ceased by a decision of the CIPM.

The scientific work of the BIPM is published in the open scientific literature and an annual list of publications appears in the *Procès-Verbaux* of the CIPM.

Since 1965 *Metrologia*, an international journal published under the auspices of the CIPM, has printed articles dealing with scientific metrology, improvements in methods of measurement, work on standards and units, as well as reports concerning the activities, decisions and recommendations of the various bodies created under the Metre Convention.

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR UNITS

on 16 April 1996

President

I.M. Mills, International Union of Pure and Applied Chemistry [IUPAC], Commission STU.

Executive secretary

D.A. Blackburn, Bureau International des Poids et Mesures [BIPM], Sèvres.

Members

Committee of the Russian Federation for Standardization, Metrology and Certification [GOST], Moscow.

International Astronomical Union [IAU].

International Commission on Illumination [CIE].

International Commission on Radiation Units and Measurements [ICRU].

International Electrotechnical Commission [IEC]: Technical Committee 25.

International Organization for Standardization [ISO]: Technical Committee 12.

International Union of Pure and Applied Chemistry [IUPAC]: Commission STU.

International Union of Pure and Applied Physics [IUPAP]: Commission SUN-AMCO.

National Institute of Metrology [NIM], Beijing.

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

National Physical Laboratory [NPL], Teddington.

National Research Laboratory of Metrology [NRLM], Tsukuba.

Organisation Internationale de Métrologie Légale [OIML].

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig and Berlin.

H.H. Jensen, Copenhagen.

M.L. McGlashan*, London.

L. Villena, Madrid.

The Director of the Bureau International des Poids et Mesures [BIPM], Sèvres.

* We regret to report on the death of Professor McGlashan on 18 July 1997.

CONSULTATIVE COMMITTEE FOR UNITS

REPORT OF THE 12TH MEETING

(16-17 April 1996)

TO THE COMITÉ INTERNATIONAL DES POIDS ET MESURES

Agenda

1 Opening of the meeting; designation of a rapporteur.

2 Report on the 84th meeting of the CIPM.

3 Seventh edition of the SI brochure:

- 3.1 General discussion of the SI brochure;
- 3.2 Report from working group 1: the neper and the bel;
- 3.3 Report from working group 2: the gon;
- 3.4 Report from working group 3: prefixes;
- 3.5 Report from working group 4: rules for writing units and numbers in the SI;
- 3.6 Proposal for amendment of Section IV of the sixth edition of the SI brochure;
- 3.7 The mole and the unified atomic mass unit (definition of the mole and of other base units).

4 Production of the new SI brochure.

5 The becquerel.

6 The OIML paper.

7 Any other business.

1 OPENING OF THE MEETING; DESIGNATION OF A RAPPORTEUR

The Consultative Committee for Units (CCU) held its 12th meeting at the Bureau International des Poids et Mesures, at Sèvres; four sessions were held, on 16 and 17 April 1996.

The following were present: Mrs S. Débarbat (IAU), Dr P. Drath (PTB), Dr R. Galle (OIML), Dr J. Gallop (NPL), Dr H. Imai (NRLM), Prof. J. Kovalevsky (Secretary of the CIPM, President of the CCDS), Dr C.E. Kuyatt (IEC), Prof. M.L. McGlashan, Prof. I.M. Mills (President), Dr B.W. Petley (IUPAP/SUN-AMCO), Dr T.J. Quinn (Director of the BIPM), Dr B.N. Taylor (NIST), Dr A.J. Thor (ISO).

Invited: Prof. B. Guinot (on 16 April).

Also present: Prof. P. Giacomo (Director Emeritus of the BIPM); Dr D.A. Blackburn, Mrs D. Le Coz (BIPM).

Apologies for absence were received from the CIE, the ICRU and from Prof. J. de Boer and Prof. L. Villena.

Absent: the GOST, the NIM and Prof. H.H. Jensen.

Dr Quinn, Director of the BIPM, welcomed the participants. Dr Gallop was appointed Rapporteur to be assisted by Dr Blackburn. The agenda was adopted.

Dr Quinn reported with regret the death of Mr Moreau, former secretary to the CCU who, for a period extending over many years, had given exceptional service to the Committee.

2 REPORT ON THE 84TH MEETING OF THE CIPM

In the absence of Prof. de Boer, Dr Quinn presented a report on the 11th meeting of the CCU to the 84th meeting of the CIPM in October 1995. As the report of that CIPM meeting was in press at the time of the 12th CCU meeting, Dr Quinn gave a verbal summary. He told the meeting that there had been extended discussion of the CCU report by the CIPM, but that no formal approval was given to adopt the proposals made by the CCU at its 11th meeting. (These proposals call for the transfer of units between tables for the seventh edition of the SI brochure.) The CIPM prefers to make changes very slowly since it does not have the authority to insist that other bodies follow its recommendations.

On the issue of binary multiples used in information technology, the CIPM agreed that it was too late to take action in view of the entrenched nature of the use of SI prefixes with “byte”.

Prof. Kovalevsky confirmed Dr Quinn’s report. He noted that individual CIPM members held differing views about how to treat units lying outside the SI. Some CIPM members view the SI brochure as both the definitive source on the SI itself and an information source on non-SI units, so they believe that it should present as much information as possible on non-SI units. Others would prefer to make as few references as possible to non-SI units.

Dr Quinn remarked that it is essential for the CCU to consider the underlying functions of the brochure and identify its priorities. He specified two functions that he considers to be of particular importance:

1) to define the SI and the rules for its use, so making it essential reading for standards-creating bodies, such as the ISO, and the editors of scientific journals.

2) to introduce the SI to a wider readership of science and technology practitioners.

He remarked that the brochure should change in an evolutionary way, and noted that international use of the SI had developed greatly since 1970.

Following discussion of the CIPM's rejection of the CCU's proposal on the use of binary multiples in information technology, it was reported that both the International Electrotechnical Commission and the Institute of Electrical and Electronics Engineers have set up working parties to consider this important issue. As these bodies are clearly concerned about this matter, it was agreed that this concern should be brought to the attention of the CIPM and that the CIPM should be invited to take note of the activities currently being undertaken by these bodies.

It was agreed that a new draft recommendation on binary multiples of units used in information technology should be submitted to the CIPM, as Recommendation U 1 (1996).

3 SEVENTH EDITION OF THE SI BROCHURE

3.1 General discussion of the SI brochure

Dr Drath questioned whether the SI brochure needs to be updated as frequently as in the past (on average every four years).

There was agreement that future editions of the brochure should be aimed at a wider audience: it should not be aimed merely at those persons responsible for the drafting of formal documents. Dr Quinn reported that 2000 copies of the sixth edition of the brochure had been printed and only 400 remained. He noted that this represents a small part of the total produced world-wide since, for example, 10 000 copies of an English language version had been distributed by the NIST and others had been distributed by the NPL.

The meeting agreed with Prof. Mills' proposal that the CCU should make decisions on the general principles underlying the structure of the new brochure, in particular on what should be included, and that Dr Quinn and Dr Blackburn should then produce a draft on the basis of these discussions for circulation to committee members.

There was general agreement on the desirability of retaining the present format, which is based on historical development, although Dr Blackburn suggested that the addition of a few hundred words, together with some restructuring of the material, could emphasize the *system* underlying the SI without losing the sense of the historical development.

3.2 Report from working group 1: the neper and the bel

The CCU discussed document CCU/96-1 produced by the working group dealing with the neper and the bel. It was recognized that there is a general problem associated with units of dimension one and that it might be appropriate to address this problem at a future date by inclusion of the unit *one*

in the table of the SI brochure listing SI derived units with special names (Table 3 of the seventh edition, *SI derived units with special names and symbols*). Prof. McGlashan pointed out that many physical quantities may be expressed as simple numbers.

Prof. Giacomo reminded the meeting that nothing in the names of the quantities expressed in the units neper or bel indicates that logarithms of ratios are involved; Dr Imai supported this view. The meeting decided that a suitably worded footnote should be included to indicate this and recognized that the neper is the coherent unit in SI, but that the bel, particularly through its decimal sub-multiple, is overwhelmingly the unit used in practice. The ISO has included both neper and bel in its documentation for many years. The meeting agreed that the proposal of the working party on the adoption of neper and bel in the table of the SI brochure listing units accepted for use with the International System (Table 6 of the seventh edition, *Non-SI units accepted for use with the International System*) should be submitted to the CIPM for consideration. A working group consisting of Dr Drath, Dr Kuyatt, Prof. Mills and Dr Thor, was set up to establish appropriate wording for the footnotes required.

3.3 Report from working group 2: the gon

Document CCU/96-2 prepared by the working group on the gon was discussed in conjunction with written comments submitted by Prof. de Boer, Dr Taylor and Dr Quinn. Points raised included the appreciation that changes in navigational practice brought about by widespread use of satellite navigation systems mean that the relation between the gon and circumferential measure at the Earth's surface is of decreasing significance. Arguments from legal metrology and the surveying community for the promotion of the use of the gon remain. The meeting agreed to postpone a decision on including the gon in the table of the SI brochure listing units accepted for use with the International System (for example Table 8 of the seventh edition, *Other non-SI units currently accepted for use with the International System*) until after comments had been sought and received from the OIMLand the International Institute of Navigation. (Dr Galle subsequently reported that the use of the gon is increasingly common in international documents on surveying.)

3.4 Report from working group 3: prefixes

At the 11thCCU meeting the view was expressed that advances in science and technology may rapidly lead to the need for prefixes which exceed the range currently specified in the SI. Further, astronomers might be encouraged to use

the SI if prefixes were available which would allow them to express astronomical distances in simple terms.

In discussion, the committee was evenly divided on this issue. One group opposed the creation of further prefixes, believing that the use of SI prefixes should be discouraged and the use of scientific notation encouraged. The other group felt that the working group's proposals were sensible and provided an initial basis for further definition.

It was agreed that the working group report on prefixes, with an invitation to return comments, should be forwarded to the following five international bodies: IEC, ISO, IUPAC, IUPAP and SUN-AMCO.

3.5 Report from working group 4: rules for writing units and numbers in the SI

The draft document from working group 4 on the writing of SI units and numbers (CCU/96-3) was then discussed.

Dr Quinn proposed the inclusion of a footnote to the draft as follows: "The comma is used in English language documents from the BIPM, and in IEC and ISO international standards. In ISO 31 and IEC 27 the comma is recommended as the only decimal marker." This modification was agreed. (Note: At its meeting in 1997, the CIPM decided that in the English text the decimal marker would be the dot on the line, treating this as a translation of the comma, the French decimal marker.)

It was agreed that in the new SI brochure the words "*for example*" in Section III.2 of the sixth edition would be replaced in each case by "*example(s)*". It was also agreed that an example of the use of cm^{-1}, in the same section, should be retained.

There was some discussion on examples showing the use and misuse of expressions representing physical quantities. It was agreed that:

- No rules should be specified for the division of mathematical equations into two or more lines of text (although the proposal given in document CCU/96-3 is in line with a recently introduced ISO rule, other rules are in widespread use at present);
- No explicit statement should be made concerning the symbol % since the SI does not formally recognize the use of this symbol (examples which use this symbol will also be dropped);
- It would be useful to include an example of how to write a negative quantity (one possibility is: $l = 7\ \text{m} - 12\ \text{m} = (7 - 12)\ \text{m}$, *but not* $l = 7 - 12\ \text{m}$).

Document CCU/96-15 was then discussed. This takes the form of a proposal to specify additional rules governing the use of unit symbols and the expression of values of quantities. This takes the form of an additional Section IV.5 suitable for inclusion in the text of the seventh edition of the SI brochure. Dr Taylor explained the logic behind the proposals which have not yet been adopted by the ISO. In detailed discussion of this paper it was agreed that, if a section of this kind were to be incorporated, paragraphs 1 and 2 would be reworded, paragraphs 3 and 6 would be used in unchanged form, and paragraphs 4, 5 and 7 would be deleted.

3.6 Proposal for amendment of Section IV of the sixth edition of the SI brochure

Prof. Mills made some opening remarks as an introduction to his new text for what was Section IV of the sixth edition of the SI brochure. He commented that non-SI units fall into three main categories:

1) units such as the hour, minute and second which will always be used universally;
2) the unit electronvolt and the unified atomic mass unit for which conversion factors are based on measurements;
3) units such as the bar and the barn which exist in the wider world, but whose use may be expected to decline.

Prof. Mills put the view that this section should present the SI in a positive sense, omitting controversial statements. Lengthy discussion followed, and the following points were agreed:

- The year should not be included in the new table listing non-SI units accepted for use with the International System (Table 6 of the seventh edition, *Non-SI units accepted for use with the International System*) since this unit has been the subject of so many definitions.
- Inclusion of the hectare should continue as a separate entry from the are.
- The three paragraphs of the introduction to Section IV should read:
  SI units are recommended for use throughout science, technology and commerce. They are agreed internationally by the CGPM, and provide the reference in terms of which all other units are now defined. The SI base units and SI derived units, including those with special names, have the important advantage of forming a coherent set with the effect that unit conversions are not required when inserting particular values for quantities in quantity equations.

  Nonetheless it is recognized that some non-SI units still appear widely in the scientific, technical and commercial literature, and some will probably

continue to be used for many years. Other non-SI units, such as the units of time, are so widely used in everyday life, and are so deeply embedded in the history and culture of the human race, that they will continue to be used for the foreseable future. For these reasons some of the more important non-SI units are listed in the tables below.
The inclusion of tables of non-SI units in this text does not imply that the use of non-SI units is to be encouraged. With a few exceptions discussed below, SI units are always to be preferred to non-SI units. It is desirable to avoid combining non-SI units with units of the SI; in particular the combination of such units with SI units to form compound units should be restricted to special cases so as to retain the advantage of coherence conferred by the use of SI units.

(Note: The table numbers in document CCU/96-20 correspond to those subsequently used in the seventh edition of the SI brochure. Some of the titles differ in detail.)

Referring to Table 6 in document CCU/96-20 (*Units accepted for use with the International System*), it was agreed to use three sets of left braces, as in the sixth edition of the SI brochure, the third set linking the neper and bel. A revision of footnote (^{b}) relating to the degree will be drafted by the working party.

In Table 7 (*Non-SI units accepted for use with the International System whose values are obtained experimentally*) an uncertainty estimate is required for the astronomical unit. Clarification on this will be sought from Prof. Kovalevsky, Mme Débarbat and the IAU. A note will be added to Table 7.

Following a suggestion by Prof. Thor, it was agreed to use the symbol “V” rather than the name “volt” in the footnote relating to the electronvolt.

In Table 8, it was accepted that the editor’s note below the table should be deleted.

It was agreed that the whole of the third paragraph in Section IV.2 of document CCU/96-20 (Section IV.3 in the sixth edition) should be deleted.

In discussing CGS units, it was agreed that the footnote on CGS units with special names should be deleted, but the stilb and phot will be retained in Table 9 (*Derived CGS units with special names*). By a majority vote it was decided to use the sign “≙” for “corresponds to” rather than replacing it with the word. It was also agreed not to group four-digit numbers into threes and that only the symbol G should be retained for gauss.

Dr Petley pointed out the importance of the unified atomic mass unit, u, to precision mass spectrometry. He noted that there is a difference between the IUPAP and ISO definitions and that in the brochure. The definition of this non-SI unit is not a CGPM matter. The problem posed by these separate definitions is that for the purposes of modern high precision mass spectrometry it is essential to indicate that the carbon 12 atoms are unbound, at rest, and in their ground state. Prof. Mills, Prof. McGlashan and Dr Thor agreed, and the proposed modification to the footnote was agreed without dissension.

In Table 10 (*Examples of other non-SI units*) the committee agreed that the symbol for torr should be "Torr". Following Prof. de Boer's proposal, and some discussion, agreement was reached that the fermi, the gamma and the micron should be moved to the foot of Table 10 with an appropriate footnote. The note presently at the foot of the Table 10 will be deleted.

3.7 The mole and the unified atomic mass unit (definition of the mole and of other base units)

Document CCU/96-7, tabled by Dr Petley on behalf of the IUPAP, concerns a modification to the definitions of the mole and the atomic mass unit so that they include the phrase "unbound and in the ground state". Following discussion, Dr Quinn pointed out that no change can be made to the definition without a decision by the CGPM. It was agreed that the SI brochure drafting committee be asked to draw up a statement, to follow the definition, which takes account of this point.

4 PRODUCTION OF THE NEW SI BROCHURE

The CCU decided to give responsibility for the production of the seventh edition of the SI brochure to Dr Quinn and Dr Blackburn. It was agreed that a draft will be circulated to all members of the CCU before being presented to the CIPM in September 1996.

Some rewording of the introduction to the new edition will clarify its intended use. This seventh edition of the brochure will address broader readership, among them all science and engineering professionals. The new edition will take into account the changes discussed at the meeting regarding Section IV (tables and unit of dimension 1), and will update Appendix II, on the practical realization of the definitions of some important units, to take account of the most recent decisions of the CGPM and the report of the CCDS working group on the application of general relativity to the metrology of time and length. The numbering of the sections will follow ISO rules.

Concerning the presentation of the definitions of the SI units in Section II of the brochure, Dr Petley pointed out the inconsistency in the method currently used to separate the definitions from the rest of the text. Italics and indents are inconsistently used as separators, particularly in the definition of the kilogram. Further, it is difficult for organizations and authors making use of the brochure to decide which parts of the explanatory text should accompany the definitions of the units and hence reach the ultimate user. He suggested that essential accompanying text should also be indented. Dr Quinn emphasized the desirability of trying to keep things as they are, but suggested that the presentational points noted by Dr Petley be left in the hands of those re-drafting this section.

Dr Petley pointed out that the agreed re-definition of the unified atomic mass unit has implications for the definition of the mole: the problem is that the

entity carbon 12 is not unambiguously specified, although it is mentioned in the note accompanying the definition. Prof. Mills (here representing the IUPAC view) and Prof. McGlashan both spoke in overall favour of a change along the lines proposed. Dr Petley indicated that several options are available, so there may be no need to change the definition of the mole. Prof. Giacomo pointed out the desirability of having a definition which contains as few caveats as possible, and mentioned the merits of a practical realization.

Dr Petley remarked out that his points concerning the mole had been submitted for publication in *Metrologia* (1996, **33**, 261-264). The CCU agreed that, if his article were published shortly, this would allow the matter to be considered by the CIPM without the need for the CCU to draft a resolution. It was agreed that the CCU need take no further action for the time being.

5 THE BECQUEREL

Dr Quinn presented a proposal (CCU/96-13) by the French Commissariat à l'Énergie Atomique (CEA) relating to the unit of radioactivity, the becquerel, suggesting that problems arise in the nuclear industry because the becquerel is too small a unit. The CEA has proposed that a special name be given to 10^6 becquerel. Dr Quinn said he did not support this idea, nor did the ICRU. The President and the participants agreed that there is no need for a change. Dr Galle added that it would be going backwards to add another unit in this field.

6 THE OIML PAPER

Dr Galle, on behalf of the OIML, presented a draft revision of the international document OIML D 2 on legal units of measurement submitted for approval to the CIML in March 1996. Dr Quinn noted that it is difficult to compare this document with the SI brochure. Almost all the units mentioned in the OIML document are in the SI brochure, and where the overlap is not complete, as with such units as the millimetre of mercury, there is no reason to adopt the missing unit. The President suggested that the neper and the bel be added to the OIML document.

7 ANY OTHER BUSINESS

The President expressed his thanks to participants for their active co-operation. He also expressed his thanks to the Director and staff of the BIPM for their hospitality and the efficient services that they had provided to ensure the smooth running of the meeting. He closed the meeting by sending his greetings, and those of his colleagues, to Prof. Jan de Boer.

Dr Quinn, speaking for all of the members of the CCU, thanked the President for his efficient conduct of the discussions during the meeting.

The Committee agreed that it is not necessary to convene a CCU meeting in the near future; a possible date is 1998, before the next CGPM, to discuss possible draft resolutions on the mole and the neper.

J. GALLOP, Rapporteur
July 1996,
revised April 1998

RECOMMENDATION OF THE CONSULTATIVE COMMITTEE FOR UNITS SUBMITTED TO THE COMITÉ INTERNATIONAL DES POIDS ET MESURES

Recommendation U 1 (1996): Binary multiples of units used in information technology*

The Consultative Committee for Units,

considering

- that the Conférence Générale des Poids et Mesures has adopted a series of prefixes to be used in forming the decimal multiples and sub-multiples of SI units,
- that there is an increasing need in information technology to express multiples of units such as the bit and byte,
- that the use of the SI prefixes in information technology to express binary multiples of such units leads to confusion,

recalling that the SI prefixes represent strictly powers of ten,

noting that work is under way, notably within the International Electrotechnical Commission (IEC) but also in other organizations, aimed at finding alternative ways of expressing binary multiples,

strongly supports the IEC in its efforts to reach agreement on names and symbols for prefixes denoting powers of two for use in information technology world-wide.

* This recommendation was adopted by the CIPM at its 85th meeting in 1996 as Recommendation 2 (CI-1996).

APPENDIX U1. Working documents submitted to the CCU at its 12th meeting

(see the list of documents on page 31)

ANNEXE U 1. Documents de travail présentés à la 12e session du CCU

Ces documents de travail peuvent être obtenus dans leur langue originale sur demande adressée au BIPM.

Document CCU/	
96-1	Working group on the neper and the bel: report and proposals to the CCU, 6 p.
96-2	Working group 2 on the gon (or grade): report and proposals to the CCU, 5 p.
96-3	Working group 4 on rules for expressing values of quantities in units of the SI: report and proposals to the CCU, 5 p.
96-4	Comments on WG reports, by J. de Boer, 3 p.
96-5	NIST (États-Unis). — Comments on report WG 2 (gon), by B.N. Taylor, 3 p.
96-6	BIPM. — The proposal to introduce the gon as unit for plane angle, by T.J. Quinn, 2 p.
96-7	IUPAP. — IUPAP paper on the seventh edition of the SI brochure, by B. Petley, 3 p.
96-8	BIPM. — Au sujet de la brochure sur le SI, Note de P. Giacomo, 3 p.
96-9	BIPM. — Au sujet du bel et du néper, Note de P. Giacomo, 2 p.
96-10	NPL(Royaume-Uni). — The mole and the unified atomic mass unit, by B.W. Petley, 5 p.

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96-11	Working group on SI prefixes: report to the CCU, by I.M. Mills, B.W. Petley (Chairman) and B.N. Taylor, 7 p.
96-12	IUPAC. — Proposal for consideration at the next meeting of the CCU, in April 1996, by I. Mills, 9 p.
96-13	BIPM. — The unit of radioactivity, the becquerel, by T.J. Quinn, 3 p.
96-14	NIST (États-Unis). — Proposed Minor Modifications to the Section on SI Prefixes for the 7th Edition of the BIPM SI Brochure, by B.N. Taylor, 2 p.
96-15	NIST (États-Unis). — Proposal for Including Additional Rules in the 7th Edition of the BIPM SI Brochure Related to Unit Symbols and Expressing the Values of Quantities, by B.N. Taylor, 2 p.
96-16	OIML. — Draft revision of International Document OIMLD 2 “Legal Units of Measurement”, 23 p.
96-17	J. de Boer. — Revision of Chapter IV, *In* Document CCU/96-12, 3 p.
96-18	J. de Boer. — Concerning Biot and Franklin, *In* Document CCU/96-12, 3 p.
96-19	J. de Boer. — Note on WG Report SI Prefixes, 1 p.
96-20	BIPM. — The International System of Units (SI) – Draft 7th Edition, 1996, 16 p.
96-21	BIPM. — Dimensions, ratios and counts, by D.A. Blackburn, 6 p.
96-22	BIPM. — Seventh edition of the SI brochure, by D.A. Blackburn, 4 p.
96-23	ISO/TC 12. — Old Table 8 – on neper and bel (draft), by A.J. Thor, 1 p.
96-24	UAI. — Draft resolution and Recommendations of Commission 4 of IAU to the IAU General Assembly (1976), 1 p.

LIST OF ACRONYMS USED IN THE PRESENT VOLUME

1 Acronyms for laboratories, committees and conferences

BIPM	Bureau International des Poids et Mesures
CCDS	Consultative Committee for the Definition of the Second
CCU	Consultative Committee for Units
CEA	Commissariat à l'Énergie Atomique, Paris (France)
CGPM	Conférence Générale des Poids et Mesures
CIE	International Commission on Illumination
CIPM	Comité International des Poids et Mesures
GOST	The State Committee of the Russian Federation for Standardization, Metrology and Certification, Moscow (Russian Fed.)
IAU	International Astronomical Union
ICRU	International Commission on Radiation Units and Measurements
IEC/TC 25	International Electrotechnical Commission, Technical Committee 25: Quantities and units, and their letter symbols
ISO/TC 12	International Organization for Standardization, Technical Committee 12: Quantities, units, conversion factors
IUPAC	International Union of Pure and Applied Chemistry
IUPAP	International Union of Pure and Applied Physics
NIM	National Institute of Metrology, Beijing (China)
NIST	National Institute of Standards and Technology, Gaithersburg (United States)
NPL	National Physical Laboratory, Teddington (United Kingdom)
NRLM	National Research Laboratory of Metrology, Tsukuba (Japan)
OIML	Organisation Internationale de Métrologie Légale

PTB	Physikalisch-Technische Bundesanstalt, Braunschweig and Berlin (Germany)
STU	Commission on Physicochemical Symbols, Terminology and Units of the IUPAC
SUN-AMCO	Commission for Symbols, Units, Nomenclature, Atomic Masses and Fundamental Constants of IUPAP

2 Acronyms for scientific terms

CGS	System of units based on three base units: centimetre, gram, second
SI	International System of Units