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COMMISSION ON NOMENCLATURE OF INORGANIC CHEMISTRY

THE NAMING OF NEW ELEMENTS

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1. INTRODUCTION

The purpose of nomenclature was stated as early as 1782 by Guyton de Morveau: ”a constant method of denomination, which helps the intelligence and relieves the memory”([1], Section I-1.1). Ideally, an element or a compound should have a unique name because the proliferation of names can lead to confusion.

A case in point, but not the only one, is element 104**,** for which the names rutherfordium and kurchatovium have been used for nearly three decades by competing laboratories. At the heart of the problem is the conviction of the discoverers that they have the sole right to name a new element. However, given a decision by IUPAC in 1947, discoverers have the right to *suggest* a name to IUPAC, but only the Commission on Nomenclature of Inorganic Chemistry (CNIC), after an examination of the suggested name to determine its suitability and a public and expert review process, may make a recommendation to the IUPAC Council. This body makes the final decision (see below).

While the origin of the names of some elements is obscure, the names of others have been based on a property of the element, a mineral from which it was isolated, its place or area of discovery, a mythological character or concept, an astronomical object, or were proposed to honour an eminent scientist**.**

2. EXISTING RECOMMENDATIONS

The recent debate on the naming of the transfermium elements has centred on three issues: (1) priority of discovery, (2) the right of discoverers to suggest names, and (3) the role of CNIC. These issues were first addressed in 1947 [2]:

”It was decided at the 1947 conference of the International Union of Chemistry, held in London, that in the future the naming of elements and all questions relating to the names and symbols of the elements should be dealt with by joint meetings of the Commissions of Inorganic Nomenclature and of Atomic Weights. Such matters had previously been dealt with by the Commission of Atomic Weights alone.

”It has been accepted in the past that the discoverers of a new element had the sole right to name it. Sometimes two different names have been given for the same element at about the same time and now it is often difficult to decide which was actually given first. Moreover, a name which was given later in point of time may have come into more general use or be more suitable than the name first given and there are cases of this kind in the International Table of Atomic Weights, so that the acceptance of a given name for an element must not be regarded as bearing any claim to priority of discovery. Priority is only one factor to be considered in deciding which is the best name for general international adoption. This presumptive right to name new elements is now accorded to the discoverers of new elements produced artificially, but subject to the approval of the Nomenclature Commission of IUPAC.”

The right of discoverers to suggest names was recognized in 1990 ([1], Section I-3.3.4):

”Elements of atomic numbers greater than 103 are often referred to in the scientific literature but receive names only after they have been discovered. Names are needed for these elements even before their existence has been established and therefore IUPAC has approved a systematic nomenclature and series of three-letter symbols for the atoms of such elements (see [1], Section I-3.3.5 and Table II).

”The existence of this systematic nomenclature does not override the right of discoverers of new elements to suggest other names to IUPAC after their claim has been established beyond all doubt in the general scientific community.”

These important quotations establish that, in the past: (1) the discoverers of new elements had the right to suggest names, (2) CNIC was given the responsibility to examine such names and to conduct a public and private review process to determine their suitability before recommending one of them to the Council of IUPAC for decision, and (3) priority of discovery could, but did not have to, be taken into account. As to the involvement of the Commission on Atomic Weights, in 1949 it ceded the responsibility for naming the newly discovered elements 43, 61, 85, 87, 93–96 and elements 4, 41, 71, 72, 74 and 91, for which two

or more names were current, to CNIC [3]. Furthermore, it could be established that, in 1957, the Commission on Atomic Weights was not involved in the naming of elements 99-102 [4].

The following quotations are relevant to the selection of names:

> "Any new metallic elements should be given names ending in -ium".[2]

> "...Other elements recognised (or discovered) during the past three centuries were named according to various arbitrary associations of origin, physical or chemical properties, etc., and more recently to commemorate the names of some famous scientists." ([1], Section I-3.3.1)

> "...It is desirable that the names of elements in different languages differ as little as possible. The names approved by IUPAC are based on considerations of practicality and prevailing usage. It is emphasised that the IUPAC selection carries no implication regarding priority of discovery." ([1], Section I-3.3.2)

This strategy and the guidelines formulated in 1947 should obviate the problem of multiple names from different laboratories for the same element. The responsibility for formally recommending a name to the Council of IUPAC rests solely with the Division of Inorganic Chemistry (DIC) [5], which now follows the procedure outlined below for recommending a name to the Council of IUPAC. This procedure differs from the IUPAC guidelines of 1947 in that priority of discovery [6] will be assigned by a joint IUPAC-IUPAP Working Group, and that only the laboratory(ies) to which priority has been assigned is (are) allowed to recommend a name. The issue of priority applies only to newly discovered elements; when the priority of discovery of already-named elements is successfully challenged, then these elements will not be renamed [7].

3. CHOICE OF NAMES FOR NEW ELEMENTS

In keeping with tradition, elements are named after:

(a) a mythological concept or character (including an astronomical object),

(b) a mineral, or similar substance,

(c) a place, or geographical region,

(d) a property of the element, or

(e) a scientist.

To avoid confusion in the literature, when a name has been in unofficial use for a particular element, but a different name is ultimately chosen for that element, then the first name cannot be transferred for use for another element.

For linguistic consistency**,** the names of all new elements should end in '-ium.'

4. PROCEDURE FOR NAMING A NEW ELEMENT

4.1. Formal proposal of a name

If the existence of a new element has been established beyond a reasonable doubt by a joint IUPAC-IUPAP Working Group, the discoverers will be invited to propose a name and symbol to IUPAC for consideration. The proposal must be accompanied by a justification of the choice. If no such proposal is received within six months, DIC shall take the initiative to propose a name, which will be submitted to the Council of IUPAC within two years of initiating the process. Similarly, when, in the case of a joint discovery, the laboratories involved cannot agree on a name and symbol within six months, then DIC shall take the initiative.

4.2. DIC Examination and public review

DIC will examine the proposed name and symbol for suitability and, if satisfied, take these through accepted IUPAC procedure [8]. This, briefly, consists of sending the recommendation to 15 experts, officers of other interested commissions, the Interdivisional Committee on Nomenclature and Symbols, the National and Regional Centres and interested individuals. The opinion of IUPAP will also be sought. Should difficulties arise in any of these processes that make the proposed name unacceptable, then DIC will correspond with the laboratory or laboratories concerned to seek their agreement to any necessary changes or to an alternative name suggested for its consideration.

4.3. Formal naming of the element

When these processes are complete, DIC passes its final recommendation through the President of the Inorganic Division to the Council of the IUPAC for formal approval by the Union and publication in *Pure and Applied Chemistry*.

4.4. Interim names

Prior to and during the naming process, the element may be referred to by its atomic number, as in 'element 118'. If a symbol is needed, the systematic, provisional three-letter symbol should be used (see Section I-3.3.5 and Table II of Ref. 1) [9].

REFERENCES AND NOTES

1. IUPAC. *Nomenclature of Inorganic Chemistry 1990,* G.J. Leigh, (Ed.) Blackwell Scientific Publications, Oxford, 1990 (The Red Book).
2. IUPAC. Commission de Nomenclature, Tentative rules for inorganic nomenclature. In *Comptes Rendus de la Dix-Septième Conférence, Stockholm, 1953*. pp. 98-119 (1953).
3. IUPAC. Commission des Poids atomiques. In *Comptes Rendus de la Quinzième Conférence, Amsterdam, 1949* (1949).
4. IUPAC. Commission on Nomenclature. In *Comptes Rendus de la Dix-Neuvième Conférence, Paris, 1957*, pp. 93-93 (1957).
5. As of January 1, 2002, the Division of Inorganic Chemistry (DIC) is the IUPAC body that assumes the responsibilities of the former Commission on the Nomenclature of Inorganic Chemistry (CNIC) regarding the naming of elements. The Interdivisional Committee on Nomenclature and Symbols is responsible for the coordination of nomenclature and symbol proposals within IUPAC and with other bodies.
6. A.H. Wapstra, D.H. Wilkinson, I. Ulehla, R.C. Barber, N.N. Greenwood, A. Hrynkiewicz, M. Lefort, M. Sakai, and Transfermium working group of IUPAC and IUPAP, Criteria that must be satisfied for the discovery of a new chemical element to be recognized. Phase 1. *Pure Appl.Chem.* **63**, 879-886 (1991).
7. To avoid confusion, the suggestion by Paneth that elements be renamed after priority has been reassigned, is not followed. F.A. Paneth, The making of the missing chemical elements. *Nature* **159**, 8-10 (1947).
8. *IUPAC Handbook 2000-2001,* Blackwell Science, Oxford (2000).
9. J. Chatt, Recommendations for the naming of elements of atomic numbers greater than 100. *Pure Appl.Chem.* **51**, 381(1979).