

The Origins of the Symbols *A* and *Z* for Atomic Weight and Number

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Question

What is the origin of the symbols *A* and *Z* for atomic weight and number?

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Answer

Though neither symbol seems logical from the standpoint of an English-speaking chemist, they make perfect sense to someone who speaks German, as they are abbreviations for the German words *Atomgewichte* or “atomic weight” and *Zahl* or “number.” Until recently, a lower-case *z* was also widely used in the electrochemical literature to represent the number of ionic charges and appeared not only in Faraday’s law (1):

$$it = zFN \quad [1]$$

and the Nernst equation:

$$E = E^\circ - (RT/zF)\ln Q \quad [2]$$

but also in such thermodynamic relationships as:

$$\Delta G = -zFE \quad [3]$$

The precise origins of the use of an upper-case *Z* for the number of nuclear charges are more difficult to trace. Most of Bohr’s early work on the quantized Rutherford atom was published in English and, in keeping with this, he used the letter *N* rather than *Z* to represent the number of nuclear charges (2), a practice that was also adopted by Moseley in his seminal papers on the correlation between atomic numbers and X-ray spectra (3). The most likely source for the switch to the German symbol lies in Arnold Sommerfeld’s (figure 1) later refinement of the original Bohr model, as most of



Figure 1. A young Arnold Sommerfeld (1868-1951).

Sommerfeld’s work originally appeared in German rather than English (4). An additional factor which may have played a role in the universal adoption of the German, rather than the English, symbol is that the latter has the disadvantage of possible confusion with the symbols for both nitrogen and Avogadro’s number. In any case, by the late 1920s, the use of *Z* rather than *N* for atomic number and nuclear charge was virtually universal (5).

Literature Cited

1. M. L. McGlashan, *Physico-Chemical Quantities and Units*, Royal Institute of Chemistry: London, 1968.
2. This symbolism was introduced in Part II of Bohr’s

1913 trilogy. See, N. Bohr, "On the Constitution of Atoms and Molecules. II. Systems Containing Only a Single Nucleus," *Phil. Mag.*, **1913**, 26, 476-502. Reprinted in L. Rosenfeld, Ed., *Niels Bohr, Collected Works*, North Holland Publishing: Amsterdam, Vol. 2, 1981, pp. 188-214. The same symbolism is also used in other early papers of Bohr reprinted in this volume.

3. H. G. J. Moseley, "The High-Frequency Spectra of the Elements," *Phil. Mag.*, **1913**, 26, 1024-1034; *Ibid.*, **1914**, 27, 703-713. In Part I Moseley used N not only for atomic number but also for Avogadro's number and for Rydberg's constant, thus providing an excellent example of the potential for confusion associated with the English abbreviation.

4. A. Sommerfeld, *Atombau und Spektrallinien*, Vieweg: Braunschweig, 1919. The 1923 English translation

of the 3rd German edition retained Sommerfeld's use of Z for the number of nuclear charges. See A. Sommerfeld, *Atomic Structure and Spectral Lines*, Dutton: New York, NY, 1923, pp. 13, 62-65.

5. See, for example, A. E. Ruark, H. C. Urey, *Atoms, Molecules and Quanta*, McGraw-Hill: New York, NY, 1930.

Do you have a question about the historical origins of a symbol, name, concept or experimental procedure used in your teaching? Address them to Dr. William B. Jensen, Oesper Collections in the History of Chemistry, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221-0172 or e-mail them to jensenwb@ucmail.uc.edu