

The Misinterpretation of Entropy as “Disorder”

Frank L. Lambert*

Department of Chemistry, Occidental College, Los Angeles, California 90041, United States

ABSTRACT: This letter supports the goal of the article “Entropy: Order or Information” (DOI: 10.1021/ed100922x), showing that the article’s presentation only of Shannon’s measure of information can be strengthened by linking it to energy-based thermodynamics in chemistry—the introduction to entropy now used in most general chemistry texts for majors.

KEYWORDS: First-Year Undergraduate/General, Physical Chemistry, Thermodynamics

I welcome the recent contribution of Arieh Ben-Naim that can aid in the elimination of “disorder” from contemporary interpretations of entropy change.¹ It would have been helpful to *Journal* readers if he had cited some of the energy-related thermodynamic bases^{3–9} that were seminal in convincing 39 authors of 21 general chemistry texts for majors (and two authors of a physical chemistry text) to delete that fundamental error of “disorder” in the past decade.²

Ben-Naim’s article treats some complex changes not dealt with in general chemistry texts and thus may be most useful in physical chemistry and statistical mechanics. However, it is vital to point out that his well-presented content is unduly limited in that it is based solely on Shannon’s measurement of information in the expansion of gases. Thus, readers are unaware that an energy-based thermodynamic view of entropy—now presented in so many chemistry texts²—deals with such expansions as simply the spreading of molecular energy of each gas species into larger volumes.

■ AUTHOR INFORMATION

Corresponding Author

*E-mail: flambert@att.net.

■ REFERENCES

- (1) Ben-Naim, A. *J. Chem. Educ.* **2011**, *88*, 594–596.
- (2) The texts that have deleted “entropy is described by disorder” are listed in “What’s New” at <http://entropysite.oxy.edu> (accessed Jan 2012).
- (3) Leff, H. S. *Am. J. Phys.* **1996**, *64* (10), 1261–1271; *Found. Phys.* **2007**, *37*, 1744–1766.
- (4) Lambert, F. L. *J. Chem. Educ.* **1999**, *76*, 1385–1387. (I especially appreciate Professor Ben-Naim’s personal correction of my misstatement on p 1386 that “R embeds temperature in Boltzmann’s entropy” He wrote me that “R simply provides the dimensions of temperature; it does not embed temperature”.)
- (5) Lambert, F. L. *J. Chem. Educ.* **2002**, *79*, 187–192.
- (6) Novak, I. *J. Chem. Educ.* **2003**, *80*, 1428–1431.
- (7) Craig, N. C. *J. Chem. Educ.* **2005**, *82*, 827–828.
- (8) Scott, R. L. *J. Chem. Educ.* **2006**, *83*, 1071–1081.
- (9) Kozliak, E. I. *J. Chem. Educ.* **2007**, *84*, 493–498.

Published: January 17, 2012