

Comment on “Historical Observations on Laws of Thermodynamics”

C. Fernández-Pineda[†] and S. Velasco^{*‡}

[†]Departamento de Física Aplicada I (Termología), Universidad Complutense, 28040 Madrid, Spain

[‡]Departamento de Física Aplicada, Universidad de Salamanca, 37008 Salamanca, Spain

In the paper of Sandler and Woodcock¹ one reads that the term “zeroth law” (of thermodynamics) first appears in the literature in 1939 in a book by Fowler and Guggenheim.² This is also the opinion of others.^{3–6} However, other authors^{7–9} attribute this term to Fowler in 1931. This is an old controversy in thermodynamics literature.

The allocation of the date of 1931 is due to Kestin.⁷ However, in the list of Fowler's publications compiled by Milne in 1945,¹⁰ no publications related to the zeroth law appear. The conjecture that Kestin is the first in attributing to Fowler the term “zeroth law” in 1931 is suggested by the Sommerfeld book *Thermodynamics and Statistical Mechanics*.¹¹ In page 1 of this book one reads: “following a suggestion by R. H. Fowler,¹ we shall refer to it as to the ‘Zeroth Law’ of thermodynamics”. The corresponding footnote is: “¹When given an account of the book of Thermodynamics of the great Indian astrophysicist M. N. Saha and his collaborators, B. N. Srivastava, Allahabad 1931 and 1935”. The translator of the Sommerfeld book from German into English was Kestin. To check that the above note was not added by Kestin, we consulted the German edition¹² not finding any addition to the English version from the German.

The two editions, 1931 and 1935, of the book by Saha et al. correspond to two books with different titles. The 1931 edition is entitled *A Text Book of Heat (including Kinetic Theory of Matter, Thermodynamics, Statistical Mechanics, and Theories of Thermal Ionization)* (Allahabad: The Indian Press Ltd., 1931), while the 1935 edition is entitled *A Treatise on Heat (including Kinetic Theory of Gases, Thermodynamics and Recent Advances in Statistical Thermodynamics)* (Allahabad and Calcutta, The Indian Press Ltd., 1935). By searching for possible reviews of the books by Saha et al. in journals from the United Kingdom in the 1930s we found the two following accounts:

1. Advances in Heat Studies. *Nature*, Vol. 130, pp 794–795 of November 26, 1932, authored by N. M. B., not identified by the journal, without any reference to the zeroth law.
2. Heat a Mode of Motion: A Modern Version. *Nature*, Vol. 137, pp 554–556 of April 4, 1936, authored by R. H. F., the initials of Ralph Howard Fowler. It is in this review where the term “zeroth law” appears for the first time. Indeed, on page 555 it says: “A proper development of thermodynamics should, I am convinced, begin with the ‘zeroth’ law of thermodynamics: *There exists a variable called the empirical temperature which may be used in defining the state of any system having the property that it has the same value for all parts of a system in thermal equilibrium*” (italics in original).

As a result of the above it can be established that the term “zeroth law” was first coined by Fowler in 1936, that is, neither

in 1931 nor in 1939. However, as it is stated by Sandler and Woodcock,¹ the zeroth law is nowadays formulated following the form given in 1939 in the book by Fowler and Guggenheim.² On the page 56 of this book one reads: “As a natural generalization of experience we introduce the postulate: *If two assemblies are each in thermal equilibrium with a third assembly, they are in thermal equilibrium with each other.*” Some lines later one reads: “This postulate of the ‘Existence of Temperature’ could with advantage be known as *the zeroth law of thermodynamics*” (italics in original).

■ AUTHOR INFORMATION

Corresponding Author

*E-mail: santi@usal.es.

Notes

The authors declare no competing financial interest.

■ REFERENCES

- (1) Sandler, S. I.; Woodcock, L. V. Historical Observations on Laws of Thermodynamics. *J. Chem. Eng. Data* **2010**, *55*, 4485–4490.
- (2) Fowler, R. H.; Guggenheim, E. A. *Statistical Thermodynamics: a Version of Statistical Mechanics for Students of Physics and Chemistry*; Cambridge University Press: New York, 1939; pp 56–57.
- (3) Redlich, O. The so-called zeroth law of thermodynamics. *J. Chem. Educ.* **1970**, *47*, 740.
- (4) Haase, R. *Thermodynamics of Irreversible Processes*; Addison-Wesley: Reading, MA, 1969; p 4.
- (5) Bergthorsson, B. Temperature, transitivity and the zeroth law. *Am. J. Phys.* **1977**, *45*, 270–271.
- (6) Carrington, G. *Basic Thermodynamics*; Oxford University Press: Oxford, 1994; p 77.
- (7) Kestin, J. *A Course in Thermodynamics*; Ginn: Waltham, MA, 1966; Vol. I, p 40.
- (8) Zemansky, M. W.; Dittman, R. H. *Heat and Thermodynamics*, 7th ed.; McGraw-Hill: New York, 1997; p 9.
- (9) Bejan, A. *Advanced Engineering Thermodynamics*, 2nd ed.; John Wiley: New York, 1997; p 17.
- (10) Milne, E. A. Ralph Howard Fowler. *Obituary Notices of Fellows of the Royal Society* **1945**, *5*, 75–78.
- (11) Sommerfeld, A. *Thermodynamics and Statistical Mechanics*, 5th ed.; Academic Press: New York, 1967; p 1.
- (12) Sommerfeld, A. *Thermodynamik und Statistik*; Dieterich'sche Verlagbuchhandlung: Wiesbaden, 1952; p 1.

Received: January 18, 2012

Accepted: February 20, 2012

Published: March 2, 2012