Topic2915

Time and Thermodynamics (Timenote)

We note two comments in monographs dealing with thermodynamics.

One comment [1] states that '… thermodynamics deals with systems at equilibrium, time is not a thermodynamic co-ordinate.'

The reference here is in the context of systems at equilibrium [1].

A stronger statement with a different view is made by McGlashan [2]. Thus

'We shall be using time t as one of our variables in this chapter. There are those who say that time has no place in thermodynamics. They are wrong.'

Some history sets the scene.

Once upon a time chemists used the calorie as a unit of energy. In fact there were three different units named calorie: thermochemical calorie, international calorie and 15^0C calorie. In common they defined energy in terms of the amount of energy required to raise by one Kelvin, the temperature of one gram of pure liquid water under specified conditions of temperature and pressure. Time is not mentioned, directly or indirectly, in this definition. Then Joule showed there is an equivalence between heat and mechanical energy. It is just a small step to relate thermal energy to kinetic energy and, hence, to time. If a calorimetric definition of energy had been adopted, then its unit would be a base unit. In practice, this would be a regression to the situation before Joule determined the mechanical equivalent of heat.

Wood and Battino [1] and McGlashan[2] are both right. Time is an important thermodynamic variable for formulating the conditions under which systems approach an equilibrium state. However, time is not used to describe the properties of these systems after equilibrium is attained.

Footnotes

[1] S. E. Wood and R. Battino, Thermodynamics of Chemical Systems, Cambridge Univeristy Press, Cambridge,1990, page 2.

[2] M. L. McGlashan, Chemical Thermodynamics, Academic Press, London, 1979, page 102; the footnotes in this text are often provocative.