Teaching Thermodynamics – A New Concept

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Thermodynamics is generally considered a difficult science. Its historical development has given this discipline a complicated and abstract structure unlike anything else in other areas of chemistry and physics thereby making an intuitive understanding a rather hopeless task.

Two thermodynamic quantities are especially difficult to grasp: entropy S and chemical potential μ. The concept first conceived by Georg Job [1] begins with the insight that formalization of a layperson's perception of amount of heat leads immediately to the quantity that is called entropy today. This term may be introduced in the same simple manner as the basic quantities length, time and mass. We use a phenomenological description (comparable to a "wanted poster" of a person) complemented by a direct measuring procedure. Similarly, it is also possible to introduce the chemical potential which avoids the detour via enthalpy and Gibbs energy. These and other quantities turn out to be dispensable. On this basis, a consistent and complete theory of the dynamics of heat and matter [1-3] can be developed, that includes both classical and statistical thermodynamics. One of the advantages of this new concept is a uniform description of mechanical, electrical, thermal and chemical systems. Furthermore, macroscopic and microscopic, reversible and irreversible, and static and kinetic systems can be treated with the same conceptual and mathematical tools. An optimized calculus allows very short calculations whose results are intuitively predictable and controllable. Since all quantities used afford an intuitive interpretation, the new concept can be easily adapted to all levels of education. It is already a part of textbooks for schools in Germany [4, 5] and Switzerland [6].

Theory is complemented by more than a hundred illustrative, simple and safe demonstration experiments [3] (partly available as video films) which make use of the motivating power and fascination of phenomena experienced firsthand.

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References

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