

Subject:

If heat is supplied to a body, then the body will contain more heat. If the body delivers heat, then at the end it has less. A person who is not educated in physics will surely not object to these statements. However, physics teaches us that they are incorrect: One can supply heat to a body, but thereafter it has none, and although it does not possess heat, one can extract heat from it. It looks like magic. The top hat is empty, but out of it comes a rabbit. Physics tells us that supplying or extracting heat does not change the heat content of a system, it changes the internal energy or enthalpy, depending on how the heat is supplied. The fact that energy is not called heat as soon as it arrives in the body is more than just a convention. There simply is no means to tell how much heat is contained in a body. In physics text books, this irritating circumstance is expressed in different ways. Some authors express it courageously [1]. Others risk doubtful justifications by maintaining that the internal energy can be divided in fractions, which they themselves would be unable to quantify [2], [3] (see also [4]). Sometimes heat and internal energy are simply taken to be identical [5].

Deficiencies:

I cannot imagine that even a single pupil will understand why it is incorrect to say that the heat supplied to a body remains inside the body. Most of our university students also would be unable to give an explanation. The statement appears to the student either only as sophistry, or it is memorized together with the numerous topics that one does not understand, and does not necessarily need to understand.

Origin:

For the description of the heat supply to a body one would need a quantitative measure of heat. The "heat" of the physicist as a "process variable" [6] is as poorly suited for this as the internal energy or the enthalpy so beloved by chemists. See also [7], [8].

Disposal:

It is particularly simple. One describes the process with the entropy. Entropy corresponds exactly to a non-physicist's idea of heat. If one heats something up, one supplies it with entropy, and after the entropy is supplied, the entropy is in it. It is easy to give a value for how much entropy is within a body, and still easier to quantify how much the entropy changes when warming the body up [9].

[1] Galileo 9 (Oldenbourg 2000) p. 98: "Warning! Differentiate very carefully between heat, internal energy and temperature: An object does not possess heat, but internal energy!"

[2] Spektrum Physik (Schroedel Velag Hannover 2000) p. 17: Under the heading "the portions of the internal energy" are specified: the kinetic en-

ergy of the particles; the energy, which is in the co-operation of the particles; chemical energy and nuclear energy.

[3] Galileo 9 (Oldenbourg 2000) p. 93: "The energy of an object, which is not to be described as mechanical energy (potential or kinetic energy), one calls internal energy E_i . The atomic energy, the chemical and the biological energy all belong to the internal energy. A substantial portion is also the energy which is connected with the temperature of the object."

[4] *G. Job*, Energieformen in Altlasten der Physik, Aulis Verlag Deubner Köln, 2002, p. 11.

[5] Metzler-Physik (Metzlersche Verlagsbuchhandlung Stuttgart 1988) p. 60: "In all of these cases the bodies are performing frictional work; thereby a part of this mechanical energy is transformed into an energy form that cannot be transformed back into mechanical energy, but is given away as heat energy or internal energy to the environment inside or outside of the system."

[6] *F. Herrmann*: State Variables

[7] *G. Job*: Equivalence of Heat and Work

[8] *G. Job*: Entropie in Altlasten der Physik, Aulis Verlag Deubner Köln, 2002, p. 85.

[9] *F. Herrmann*: Die Messung der Entropie in Altlasten der Physik, Aulis Verlag Deubner Köln, 2002, p. 87.

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