9 Tendency to the energy minimum

Subject:

The common reason given as a cause of a process is that the system reaches a state of minimum energy as a result of this process:

– a pendulum comes to rest at its low point
– a floating board tilts on its side
– a soap bubble forms in a spherical shape
– a sponge sucks up water
– a quantity of electric charge distributes on a conductor
– excited gas atoms emit photons
– positive and negative ions arrange themselves in a crystal lattice
– heavy nuclei decay.

Deficiencies:

Without saying it explicitly, all of these statements assume that each system aims at a state of minimum energy and proceeds to this state, provided it is not hindered by some circumstance. Formulated this way, however, the statement doesn't make sense. If one system reaches a state of minimum energy, then the complementary system, the environment, must reach an energy maximum due to the conservation of energy. The same argument applied to the environment would yield the opposite result. Thus the above assumption cannot be valid generally. So for which system is it valid? The answer comes from thermodynamics. The system must, as W. Gibbs expressed it in 1873, be closed for everything except the energy necessary to keep the entropy constant. The entropy S_p produced by processes occurring within the system appears only in the environment, and with it the energy TS_p coming from the system, where T is the temperature of the environment. Since S_p and T are always positive, the system always loses energy, since any other energy exchange that could compensate the losses is forbidden. Seen in this way, the tendency to the minimum energy is nothing more than a consequence of the entropy principle, applied to a particular class of systems.

Origin:

In mechanics we ignore the thermal properties of things. Levers, pulleys, springs, blocks and ropes are considered objects that cannot be heated, i.e. whose temperature and entropy cannot change. In fact we are tacitly ascribing the entropy created by friction to the environment. Under these conditions, we are allowed to speak of the tendency to an energy minimum. The same applies to systems in many other parts of physics – hydraulics, electricity, atomic and solid state physics and so on. Because we don't mention the production of entropy as the cause for these processes, we get the impression of an independent natural principle.

Disposal:

We can talk about entropy production in systems explicitly. Like so often, our strained relationship to entropy misleads us to questionable surrogates. The fundamental evil, which as a consequence has endless difficulties and

opposes itself to any attempt to remedy, is the dogma of the heat as a special form of energy, which for one and a half centuries has been affectionately cared for, and which is anchored in the first law of thermodynamics. Only if we are ready for a revision can a lasting improvement be expected.

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