or heat processes—and this practically means in all natural processes—there is such a quantity which is always on the increase, and which thus measures in mathematical language the growing loss of available or useful energy in the world. Rankine simply called it the "thermo-dynamic function"; Clausius thought it important to give it a name which would co-ordinate it with energy, and he called it entropy:[1] energy which is turned inside, becomes hidden or locked up. Clausius thus gave a different wording of Thomson's doctrine of

45. Entropy.

[1] Clausius had already in 1854 (Pogg. 'Ann.,' vol. xciii. p. 481) arrived at the principal consequences and the final enunciation of what he termed "the second law of thermo-dynamics," a law which refers to the transformation, as the first refers to the conservation, of energy. He there arrives at similar conclusions to those put forth by Thomson two years earlier. The word entropy, however, was not introduced by him till 1865 (Pogg. 'Ann.,' vol. cxxv. p. 390), when he introduced it with the following remarks: "I have intentionally formed the word entropy as much as possible on the model of that of energy, for the two quantities which are to be designated by these two words are in their physical meaning so intimately related that a similarity in the terms seemed to me to be justified." As stated above (p. 167, note), Lord Kelvin, who worked simultaneously and independently at the same subject, laid more stress upon the direct statement, that in all transformations of energy we have to distinguish between the available and the total intrinsic energy, and introduced the terms energy and motivity as two functions of all the variables specifying the conditions of a system. In his article on Heat, contributed to the 'Ency. Brit.,' 9th ed., he gives the mathematical relation of motivity to entropy ('Papers,' vol. iii. p. 167). The term motivity has not become current in thermo-dynamical treatises, but the need has been very generally felt of reserving the word energy in a restricted sense for available energy, such energy as can be put to mechanical use. Wald, in a very interesting dissertation, 'Die Energie und ihre Entwerthung' (Leipzig, 1889), deplores (pp. 43 and 44) the fact that the word energy has not been reserved to denote useful, available energy. "Had the word energy," he says, "been introduced before the discovery of the first law of thermo-dynamics, then certainly only mechanical energy would have been termed simply energy." In the use of the word *Kraft* in some writers, such as Mayer, there seems occasionally a confusion between available and total or intrinsic energy. See Le Chatelier in 'Journal de Physique,' 1894.