that confusion which the indefinite use of the word had caused, especially among Continental writers. One of the first practical applications of this idea as referred to the motive power of heat in Carnot's sense was made by William and James Thomson in 1849. They had both fully realised that lowering of temperature might be accompanied by the doing of work by heat, and that elevation of heat to a higher temperature meant expense of work. If, therefore, work could be done by heat without lowering the temperature, there was an apparent gain of motive power without corresponding expenditure. It was known that water at freezing temperature expanded in becoming ice: it was capable of doing work, frequently very destructive work, without a lowering of temperature. In order to convert water into ice of the same temperature, heat must be abstracted. Here, then, was a case of a possible transference of heat without fall of temperature, and the creation or gain of great power to do work; but, according to Carnot's principle, equality of temperature implied an absence of expenditure of work. So here was a case of gain without expenditure of power simply by a transference of heat at freezing-point. James Thomson[1] saw the solution of the paradox. If water

28. Application by William and James Thomson.

[1] The reasoning of James Thomson, based again upon the impossibility of a perpetual motion, is given in the following passage of his communication to the Royal Society of Edinburgh, dated January 2, 1849 (reprinted in his brother, Lord Kelvin's, 'Math. and Phys. Papers,' vol. i. p. 156): "Some time ago my brother, Prof. William Thomson, pointed out to me a curious conclusion to which he had been led by reasoning on principles similar to those developed by Carnot with reference to the motive power of heat. It was that water at the freezing-point may be converted into ice by a process solely mechanical, and yet without the final expenditure of any mechanical work. This at first appeared to me to involve an impossibility, because water expands while