are not absolutely cold, but have a "proper heat" independent of the sun and of the planets. If there were not such a heat, the cold of the polar regions would be much more intense than it is, and the alternations of cold and warmth, arising from the influence of the sun, would be far more extreme and sudden than we find them. As the cause of this heat in the planetary spaces, he assigns the radiation of the innumerable stars which are scattered through the universe.

Fourier says,[18] "We conclude from these various remarks, and principally from the mathematical examination of the question," that this is so. I am not aware that the mathematical calculation which bears peculiarly upon this point has anywhere been published. But it is worth notice, that Svanberg has been led[19] to the opinion of the same temperature in these spaces which Fourier had adopted (50 centigrade below zero), by an entirely different course of reasoning, founded on the relation of the atmosphere to heat.

In speaking of this subject, I have been led to notice incomplete and perhaps doubtful applications of the mathematical doctrine of conduction and radiation. But this may at least serve to show that Thermotics is a science, which, like Mechanics, is to be established by experiments on masses capable of manipulation, but which, like that, has for its most important office the solution of geological and cosmological problems. I now return to the further progress of our thermotical knowledge.

Sect. 5.—*Correction of Newton's Law of Cooling.*

IN speaking of the establishment of Newton's assumption, that the temperature communicated is proportional to the excess of temperature, we stated that it was approximately verified, and afterwards corrected (chap. i., sect. 1.), This correction was the result of the researches of MM. Dulong and Petit in 1817, and the researches by which they were led to the true law, are an admirable example both of laborious experiment and sagacious induction. They experimented through a very great range of temperature (as high as two hundred and forty degrees centigrade), which was necessary because the inaccuracy of Newton's law becomes considerable only at high temperatures. They removed the effect of the surrounding medium, by making their experiments in a vacuum. They selected with great

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[18] *Mém. Inst.* tom, vii. p. 581.   [19] Berzel. *Jahres Bericht,* xi. p. 50.