THE LAWS OF RADIATION AND ABSORPTION: MEMOIRS BY PRÉVOST, STEWART, KIRCHHOFF, AND KIRCHHOFF AND BUNSEN

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RADIATION AND ABSORPTION

MEMOIRS BY PRÉVOST, STEWART, KIRCHHOFF,

AND KIRCHHOFF AND BUNSEN.

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Radiation and Absorption.
W. P. 2

PREFACE.

THE attempt of Prévost to explain the experiments of Pictet, of the apparent concentration of *cold* at the focus of a mirror, without attributing the quality of radiation to *cold*, as assumed by Pictet, lead him to the enunciation of the very important principle which he called the *movable equilibrium* of *heat*, now designated as the *theory of exchanges*. Prévost, who was a disciple of le Sage, and who had issued, with many additions, his memoirs, assumed, in addition to a corpuscular fluid caloric, a free corpuscular radiant caloric, the equal interchange of which between neighboring free spaces, constituted heat equilibrium. Any interference with this equilibrium will be reëstablished by the inequalities of the exchanges. On this principle he was able to explain the apparent concentration of *cold* and also to show the inadmissibility of *cold* as an agent susceptible of radiation. He was careful, however, to fortify his principle by showing that the same results would follow on the then distrusted hypothesis of undulatory exchanges, which has been adopted by his successors. Later experimenters, particularly Leslie and De la Provostaye and Desains, confirmed the theory and also showed in many instances quantitative relations between radiation and absorption. But the most important advance was made by Balfour Stewart in establishing, not only a quantitative relation, but also a qualitative or selective one. By the introduction of his ingenious idea of an impervious radiating inclosure he demonstrated the equality between the emissive and the absorptive power of any wave length. We owe to Kirchhoff, however, the first rigorous proof of the celebrated law (usually designated on the Continent as Kirchhoff's law) of the emission and absorption of light and heat, and the application of the same by both Kirchhoff and Bunsen to Spectrum Analysis. The radiation of solids and liquids and gases follows the law exactly when the conditions upon which he founded it are rigorously fulfilled, namely, the complete transformation from one to the other of

radiant energy and their intrinsic heat. We now know that most radiations from gases are not exclusively thermal, but that the substances, cited by Kirchhoff and Bunsen, also give off so called chemical and electrical and fluorescent radiations which Kirchhoff excluded in the proof of his law. In fact none of the gases giving line spectra at temperatures heretofore used do so by simple thermal radiation, but essentially by luminescent actions (chemical, electrical, and photogenic), so that we cannot, in general, apply the law of Kirchhoff of the proportionality between radiation and absorption to either terrestrial or celestial substances. In these cases the principle of resonance usually holds, since in luminescence the radiation of line spectra is accompanied by selective absorption of the same spectral lines, so that the law may be used qualitatively, which is in fact the way Kirchhoff and Bunsen actually attempted to confirm it. The formulation of the complete law for radiations of a *black body* is only given in part by Kirchhoff. The formula of Wien, and more particularly the most recent one of Planck, deduced on theoretical grounds, approximates closely the latest observations on a black body at different temperatures and over different wave lengths.

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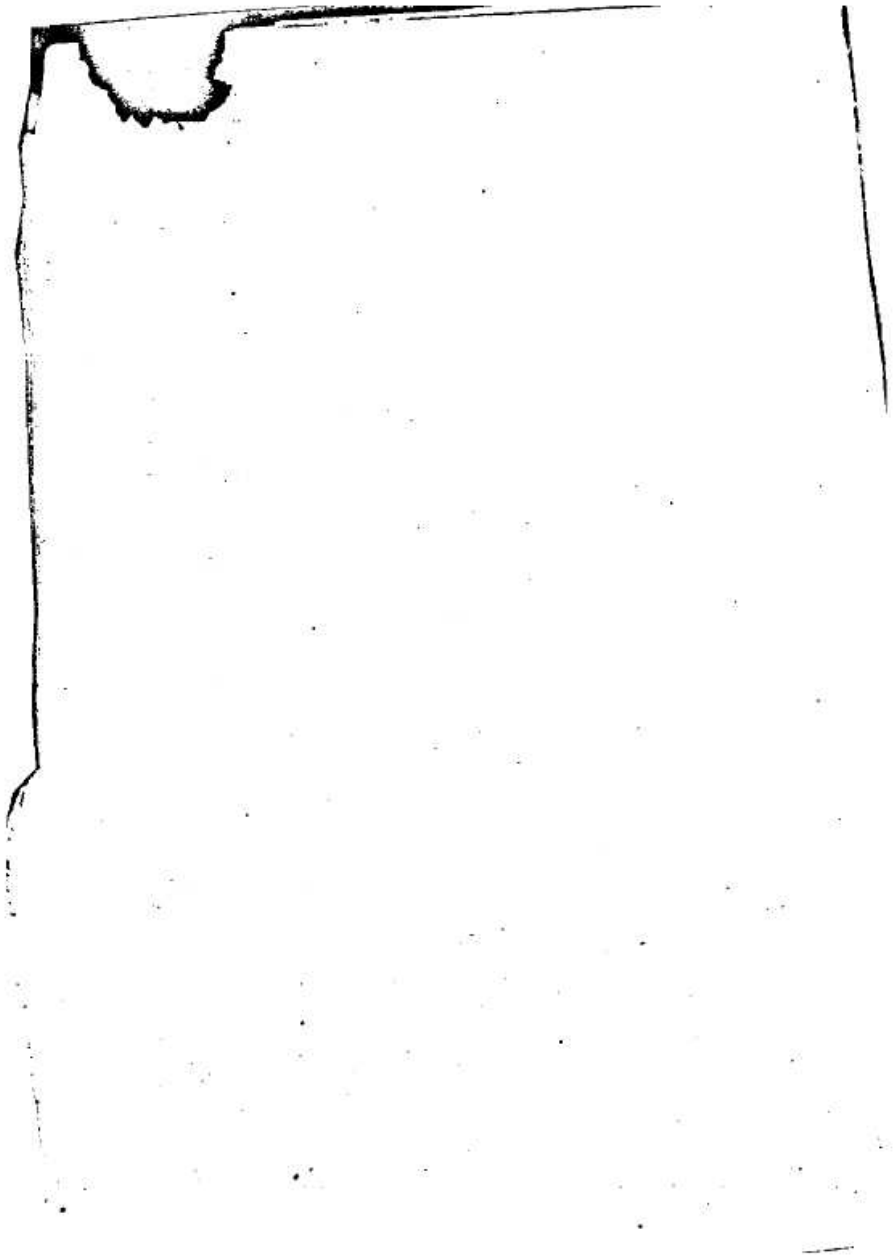

MEMOIR ON THE EQUILIBRIUM OF HEAT.

BY

PIERRE PRÉVOST.

Journal de Physique, vol. 38, *pp.* 314–322. *Paris*, 1791.