

directly or stored up in the food. An animal, like a machine, only transforms its energy. Lavoisier's guinea-pig, placed on the calorimeter, gave as accurate a heat-return for the energy it had absorbed in its food, as any thermic engine would have done. But the parallel goes further. The mechanical work of an engine is measured by the loss of its heat and not of its substance. So the mechanical or intellectual work of living beings is measured by the amount of food rather than the amount of tissue which is burned. The energy evolved daily by the human body would raise it to a height of about six miles."

The subject of muscular contraction is then discussed and regarded as due to electric discharges generated within the muscle itself and not carried to the muscle by the nerves. The electrical charge which appears in the muscular fibre, may, it is supposed, have its origin in so purely a physical cause as the contact of the heterogeneous substances of which the tissue is built up; the maintenance of this charge being effected by chemical changes going on constantly in the substance of the muscle, by which the carbon dioxide is produced, which is shown to be a measure of the work done.

"Conceding now, that muscular contraction is of the nature of an electric discharge, by what mechanism is the contraction effected? A string of electrical masses, like a muscular fibril, would seem at first to oppose the view now advanced. Such a row of particles would indeed attract each other when electrified, and shorten the length of the whole. But the force of contraction would increase as the length diminished; whereas the fact in the case of the muscle is precisely the reverse. Two theories have been advanced to account for the result. The first, proposed by Marey, likens the muscular fibre to a string of india-rubber which, when stretched, contracts upon the application of heat, thus transforming heat directly into work. The other, brought forward and strongly supported by Radcliffe, explains contradiction by direct electric charge. Each fibre of the muscle, together with its sheath, constitutes a veritable condenser, the charge upon the exterior being positive, and upon the interior negative. When a charge is communicated to the fibre, literal compression results from the attraction of the electricities of opposite name, and since the volume remains constant, elongation is the consequence—precisely as a band of caoutchouc, having strips of tin-foil upon its sides, may be shown to elongate