

Thus the microscope, with all its brilliant contributions to knowledge of the form and more gross structural elements of the cell, hardly at all contributes to knowledge of its physico-chemical organization as a mechanism. Out of such needs a preliminary, if very imperfect, rational description of protoplasm has arisen, and gradually the physical and chemical laws governing protoplasm, its form, composition, and stability, its constituent parts and their mode of action, and the physical and chemical changes within it are being discovered.<sup>1</sup> The idea of durable form in matter and energy that change can now be applied to the cell with greater advantage, in that descriptions of the form and of the change are now at hand, though as yet all too imperfect.

Another profoundly important contribution of the science of metabolism to our knowledge of the characteristics of life is the discovery of the cycle of matter through plants and animals.<sup>2</sup> The plant takes up carbonic acid and water and a few other simple substances from air and soil, and

<sup>1</sup> This subject is extensively treated by Höber, "Physikalische Chemie der Zelle und der Gewebe." Leipzig, 1911, 3d ed.

<sup>2</sup> This was originally clearly stated by Lavoisier.