by the assumed destruction of some elementary part of the substances under examination, or the formation of a new portion from the air, which was, as Professor Crookes aptly says, looked upon not "as the common instance of a condition to which all matter could be reduced, but a something very closely bordering upon nothing." With such vague and false notions, it is not wonderful that many of the most common facts escaped observation, or were misinterpreted. Manufactures were carried on according to traditional rules of thumb. Physiological processes were explained wholly by the activity of a mysterious vital force, and medicinal treatment was very largely on a par in rationality with Indian incantation. The physicist was hindered in the study of mechanical problems by the mysterious behavior of that "imponderable matter," heat.

But the studies of a century have brought about many radical changes in the popularly accepted ideas of matter. Now, it is regarded as something which no finite being can, by any process create or destroy; both matter and force, although their essential nature may be as little known as ever, are far more sharply distinguished as factors in phenomena; furthermore, much that early physiologists attributed to the action of vital force, is now admitted to be satisfactorily explained by purely chemical and physical laws.

Professor Crookes summarizes the important points directly established by chemical research, in the following words:—"We see that to chemistry we owe the notions of the permanence of matter, of the gaseous condition, of the nature of the atmosphere, of combustion and of oxidation, of elements, of composition and decomposition in definite proportions, and of organic synthesis."

Limited space prohibits the discussion of the relation of chemical research to the improvement and extension of the experimental method to other fields of investigation, the relation of the acceptance of the idea of the conservation of matter, to the fruitful generalization of the conservation of energy.

Let us for a moment, turn our attention to the effect of the ideas gathered from chemical research, upon the practical methods of manufacture as far as they relate to the utilization of waste products.

Although the past fifty years have been marked by the development of many new manufactures, and the addition of hundreds of new chemical products to trade lists, sage observers remark that this period is even more distinguished by economy in production, and by the utilization of by-products of manufacture. It is claimed by many that the rich prosperity which has attended the manufacturing development of the past half-century, is chiefly due to the increased economy rigidly practiced. As far as chemistry is concerned, there are two elements in this economy: In the first place, by careful study of attendant condition, the manufacturer is able to apply the law of definite proportion to the preparation of product on a large scale, thereby reducing waste, and obtaining a purer and more uniform product. The charge for the iron furnace is calculated with as much accuracy as that for the assayer's crucible, and similar statements may be made of numerous other important industrial operations.

The second element in this economy is the utilization of by-products formerly thrown aside as useless. Thus in the beet-sugar industry, not only is the sugar more completely extracted from the pulp, but the latter is used for cattle-food; the scums from the juice are filtered, washed free from sugar, and the potash extracted, or are used directly as a fertilizer; the molasses, unfit for table consumption is converted into alcohol; the animal char used in refining, is frequently revivified by ignition, and again applied. The use of bones for the manufacture of soap-fat, glue, animal charcoal, and of bone-ash and dissolved bone as fertilizers; as well as that of butchers' waste