

planet between Mars and Jupiter, anticipating the discovery of the Asteroids, which have accordingly been regarded as the fragments of the missing planet.

27.  
Difference  
between  
chemical  
and physical  
reasoning.

It thus appears that purely "chemical reasoning," as it has been called, has proved insufficient to establish the atomic view of nature on the same firm basis as has supported the mechanical or astronomical view ever since the age of Galileo and Newton.<sup>1</sup> In the second half of the century, the atomic view of matter has however been put forward from a different side, and independent researches have, in combination with the older chemical theories, introduced so much definiteness into this line of thought that "the Newtonian theory of gravitation is

<sup>1</sup> "Many diagrams and models of compound molecules have been constructed. These are the records of the efforts of chemists to imagine configurations of material systems by the geometrical relations of which chemical phenomena may be illustrated or explained. No chemist, however, professes to see in these diagrams anything more than symbolic representations of the various degrees of closeness with which the different components of the molecule are bound together. In astronomy, on the other hand, the configurations and motions of the heavenly bodies are on such a scale that we can ascertain them by direct observation; . . . the doctrine of universal gravitation not only explains the observed motions of our system, but enables us to calculate the motions of the system in which the astronomical elements may have any values whatever" (Clerk Maxwell, "On the Dynamical Evidence of the Molecular Constitution of Bodies," June 1875, 'Scientific Papers,' vol. ii. p. 418). "The

chemists ascertain by experiment the ratios of the masses of the different substances in a compound. From these they deduce the chemical equivalents of the different substances, that of a particular substance being taken as unity. The only evidence made use of is that furnished by chemical combination. It is also assumed, in order to account for the facts of combination, that the reason why substances combine in definite ratios is, that the molecules of the substances are in the ratio of their chemical equivalents, and that what we call combination is an action which takes place by a union of a molecule of one substance to a molecule of the other. This kind of reasoning, when presented in a proper form, and sustained by proper evidence, has a high degree of cogency. But it is purely chemical reasoning; it is not dynamical reasoning. It is founded on chemical experience, not on the laws of motion" (Id. article "Atom," 'Ency. Brit.,' 1875; *ibid.*, vol. ii. p. 456).