

is not so, except in special cases. And, again, in the instance of any effect produced by the force of a body, how are we to know whether the force resides in the whole mass as a unit, or in the separate particles? We may reason, as Newton does,²¹ that the rule which proves gravity to belong universally to the planets, proves it also to belong to their parts; but the mind will not be satisfied with this extension of the rule, except we can find decisive instances, and calculate the effects of both suppositions, under the appropriate conditions. Accordingly, Newton had to solve a new series of problems suggested by this inquiry; and this he did.

These solutions are no less remarkable for the mathematical power which they exhibit, than the other parts of the *Principia*. The propositions in which it is shown that the law of the inverse square for the particles gives the same law for spherical masses, have that kind of beauty which might well have justified their being published for their mathematical elegance alone, even if they had not applied to any real case. Great ingenuity is also employed in other instances, as in the case of spheroids of small eccentricity. And when the amount of the mechanical action of masses of various forms has thus been assigned, the sagacity shown in tracing the results of such action in the solar system is truly admirable; not only the general nature of the effect being pointed out, but its quantity calculated. I speak in particular of the reasonings concerning the Figure of the Earth, the Tides, the Precession of the Equinoxes, the Regression of the Nodes of a ring such as Saturn's; and of some effects which, at that time, had not been ascertained even as facts of observation; for instance, the difference of gravity in different latitudes, and the Nutation of the earth's axis. It is true, that in most of these cases, Newton's process could be considered only as a rude approximation. In one (the Precession) he committed an error, and in all, his means of calculation were insufficient. Indeed these are much more difficult investigations than the Problem of Three Bodies, in which three points act on each other by explicit laws. Up to this day, the resources of modern analysis have been employed upon some of them with very partial success; and the facts, in all of them, required to be accurately ascertained and measured, a process which is not completed even now. Nevertheless the form and nature of the conclusions which Newton did obtain, were such as to inspire a strong confidence in the competency of his theory to explain

²¹ *Princip.* B. iii. Prop. 7.