"centrifugal force," the difference between force and energy, the explanation of the "force of suction," the difference between electric and magnetic phenomena, where is the teacher who, by a knowledge of the struggles undergone by the master minds, will not be impressed by a deeper sympathy with students who encounter "hard points" and are at first unable to master them? More than this, the way original thinkers leveled the barriers often suggests to the teacher good methods for removing those of the pupil. The pendulum at Cayenne was acted upon by forces to a less degree than at Paris, yet its mass was the same in both places; the mass was the same, but the weight was different.

While to the instructor the history of science teaches patience, *to the pupil it shows the necessity of persistent effort.* Newton began to think of gravitation in 1666, but that coquettish maiden, the law of inverse squares, long eluded him. Jacob waited for Rachel twice seven years; Newton waited for *his* Rachel nearly thrice seven years.

A third lesson to be drawn from historical study is *the necessity of checking speculation and correcting our judgment by continual appeal to the facts, as determined by experiment.* This lesson is as important to the young pupil as it is to the original investigator. Many a young girl first entering the laboratory is afraid of deadly shocks from a harmless Leclanché cell. Let not the teacher attribute such preconceived notions to stupidity. Able minds have made just such mistakes. The great logician, Aristotle, walking up and down the paths near his school in Athens, came to the conclusion through some involved process of *a priori* reasoning that bodies fall quicker in exact proportion to their weight.[1] If it had only occurred to him to pick up two stones of unequal mass, and then drop them together, he could easily have seen that the one of, say ten times the mass did not descend ten times faster. The experiment was omitted, and Aristotle never found out his error. Nor did the readers of his books for two thousand years, until finally Galileo ascended the leaning tower of Pisa and dropped iron balls of different weights to show that a light ball will fall with the same velocity as a heavy ball.

Another conspicuous instance of a great man whose judgment was untrained by habitual appeal to the facts was Descartes. When the Copernican theory was under discussion it was claimed by many that, if the earth rotates and bullets are fired vertically upward, they must strike the ground far to the westward. Mersenne and Petit in France tried the experiment. But they were perplexed by an unexpected occurrence. They could not find their bullets at all! Descartes, the great French oracle of the time, was consulted, and he seriously replied that the bullets had received such intense velocity that they lost their weight and flew away from the earth. Such an absurd reply could never have come from experimenters like Galileo or Newton.

Another point which I desire to make is that *the history of science demonstrates the futility of the pedagogical theory according to which the pupils in the laboratory should be made to re-discover the laws of nature.* If ever a teacher undertakes an impossible task, it is he who expects to bring his pupils to the point where they, in eight or nine months, will achieve what Galileo, Gilbert, Boyle, Guericke, Newton, and a host of others, by their united strength, have thought out only after a lifetime given to scientific work. In impracticability this Utopian scheme surpasses all others. Sir Thomas More was outclassed by him who originated this pedagogical theory.

[1] *De Coelo*, Book III., chap. 2.