that case may be a true one or a false one. He may hit upon the right one, but he cannot be said to have discovered it. Some praise may be due to him even for his imagining it, but a thing can never be discovered in the proper sense, till it has been proved. He who imagines or anticipates a cause is a lucky man—he who discovers it is a good philosopher. As to the facts themselves, they are to be procured by observation and experiment. Observation refers to the appearances of things as they exist in nature, to the facts which may be taken notice of through the medium of the senses. The phenomena of the rising and setting of the heavenly bodies, could not fail to attract the attention of mankind even in the lowest state of human existence; and hence observations on the sun and moon and stars were made at the earliest period of the history of man. In Chaldea and in Egypt, they *recorded* their observations. The Egyptians observed that whenever the inundation of the Nile took place, certain stars made their appearance above the horizon at a given hour. This phenomenon depended upon the position of the star with regard to the sun in his progress through the ecliptic, and gave rise to the determination of the length of the year. It was not, however, until an immense mass of observations carefully made by Flamstead and others were published, that a sufficient foundation was laid for a theory of astronomy; but without these observations, Newton never could have proved the accuracy of his calculations, for it was only when they were found to agree with the facts, that he felt the *importance* of the discovery that the force of gravitation decreased, as the squares of the distances of the heavenly bodies increased. And so in every other science, the accurate observation of abundant facts forms the foundation of theory.* Experiment may be considered as a kind of observation—observation not of external things as they are, or their changes as they come to pass, but of natural things which we ourselves have changed. We try by experiment combinations which we do not see, or which we cannot observe naturally, in order that we may detect the laws of matter that are hid from our eyes. By observation, we look upon nature as she is—by experiment, as Sir. John Leslie used to say, we thrust nature into a corner, and extort from her the secrets of her kingdom. The facts which we get possession of experimentally, are just as valuable for the purpose of induction as those derived from observation; and the great object of the investigator should be, to be sure that they are facts—that the experiment has been conducted with caution and delicacy. There is no greater difficulty that in modern times is to be encountered in the pursuit of scientific discoveries, than the rare ingenuity—the inventive constructiveness that is requisite properly to institute experiments, and prepare instruments to extort from nature her secrets. When the pump makers to the Duke of Florence found that water would not rise higher in their pumps than 32 feet, they applied to Galileo for a solution of the problem; Galileo had recourse to the old notion, that nature abhorred a vacuum, but that her abhorrence ceased when she had destroyed one so high as 32 feet. This might have been reckoned in those times a very satisfactory explanation of the thing, and so might the explanation of the man who fell in his attempt to fly from the top of Stirling Castle, as the story is told in MacGregor's History of Stirlingshire. His reason was that his wings having been made of feathers, the feathers were attracted by the feathers of a number of hens that were below him, and that was the reason why he fell upon the dung-hill. This might have been considered as good philosophy then by many; but Galileo's solution of the problem why the water did not rise higher than 32 feet in the pump, was not satisfactory to his pupil Toricelli. He suspected that it must be the weight of the atmosphere that caused the water to ascend 32 feet, and that the weight of the column of water balanced the pressure of the atmosphere. But how to prove this was another thing. He proved it by an experiment. If it was the weight of the atmosphere that counterpoised the 32 feet of water, he saw that it would follow, that by the substitution of mercury for water, the column of mercury in order to be balanced by the weight of the air, would be less than 32 feet, by so much as mercury is heavier than water, that is, that mercury in the same circumstances as the water would stand at the height of 28 inches. Filling a tube with mercury, close at one end and open at the other, he turns the tube upside down, placing the open end in a vessel of mercury—the *column* of mercury remained at the height he anticipated, which as it varies a little with the variable height of the atmosphere, forms a barometer or weather glass. This experiment of Toricelli exhibited a fact which conducted directly to the discovery of the cause: but in many cases a series of experiments, and these sometimes very complicated, are necessary for facts sufficient for a proper induction. With respect both to observation and experiment, the philosophy of Bacon demands, that the facts which

* There is no such thing, properly speaking, as a false theory. A theory is either true, or no theory at all. When people speak of a false theory, they mean a hypothesis.