

I. GALILEO GALILEI

1564-1642

BIOGRAPHICAL STUDY

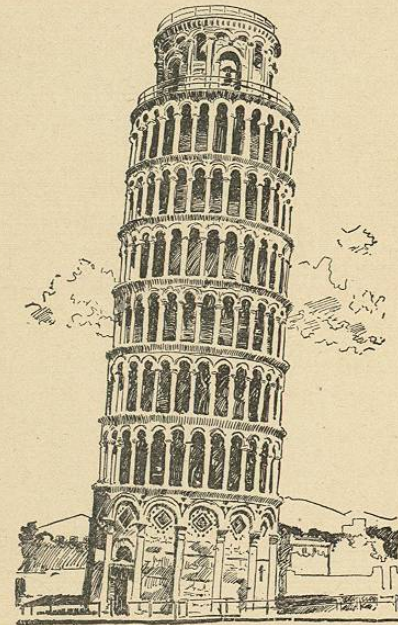
BY JOHN EBENEZER BRYANT, M. A.

From the very beginning of his civilization man took an interest in the motions of the heavenly bodies, but for ages his knowledge of their motions was incorrect. It was all based on the assumption that the earth was a fixed central point round which the sun, the moon, the planets, and the stars, revolved in their several courses. This assumption corresponded with the notion which people got of the matter from their ordinary observation. But, what was of greater moment, it corresponded also with the supposed teachings of the scriptures. In the middle ages the church was omnipotent, and whatever it wished the people to believe it took care they did believe. Disbelief, indeed, frequently resulted in death. The doctrine that the earth was the center of the universe, and that sun, moon, and stars revolved around it, the church declared was taught in the scriptures, and therefore it was one that the people were required to believe. Unfortunately, it was also one that was

out obtaining the doctor's degree, which alone would permit him to practice.

Galileo was thus barred from entering upon the profession which he had chosen as a means of livelihood, but the seeming adversity was in reality a piece of good fortune. It determined his lot in life. He went home and at once began to pursue with ardor those studies with which afterward his great fame was to be associated. Galileo's genius for physical investigation was the greatest that up to his era, so far as is known, was ever given to man; and even since his era we have to come down as late as Faraday before we can find his peer. When a young student in the university he had, by watching the oscillations of the great lamp in the cathedral, which a verger had left swinging to and fro, discovered the physical fact of the isochronism of the pendulum, the fact upon which the principle of all modern clock-making is based. Though he did not invent the modern clock, he at once turned his knowledge of the fact he had discovered to practical use in the professor he was then preparing for by devising an instrument for determining the rate of the pulse-beat. By the time he was twenty-four he had earned for himself a widespread reputation as a bold and original investigator of mechanical and other physical laws. At twenty-six he was appointed professor of mathematics in the University of Pisa, the university that six years before he was too poor to obtain his degree from. Three years later he was promoted to a similar position in the University of Padua. Galileo was not merely a bold thinker and a clever, original investigator. He was also an able and convincing lecturer and demonstrator. His facility of illustration, his wit and his humor in the presentation of his themes, as well as his

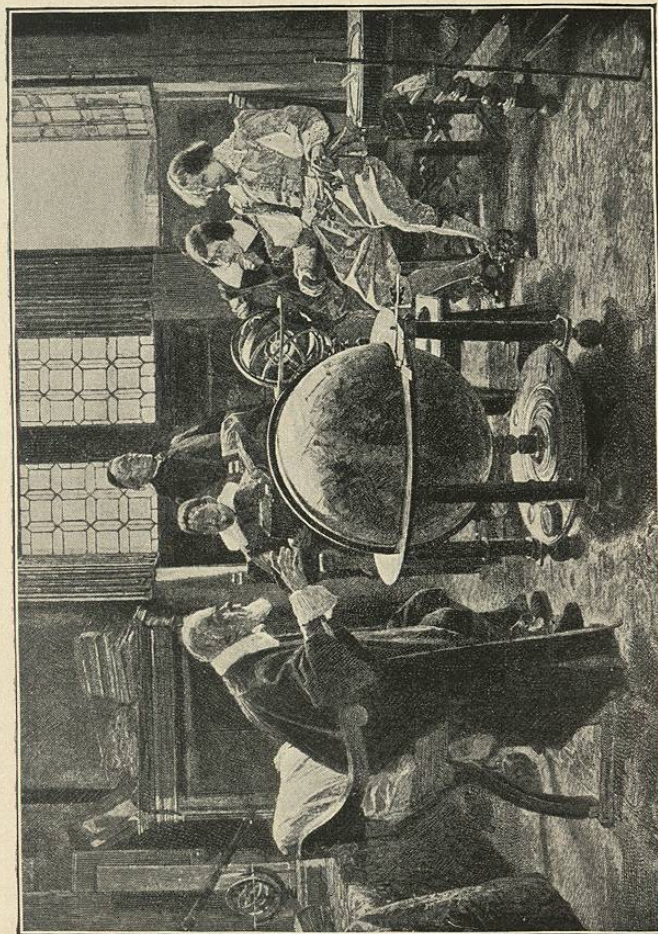
clinching logic, made him the most popular teacher of his age. People flocked to hear him who were not professional students. Sometimes, because of crowds, he had to resort to large halls. Sometimes, too, he had to resort to the open air. He was besides equally skilled and renowned as a writer. His scholarship and literary skill and grace, together with his fame as an investigator, made his correspondence sought for by all the learned men in science in Europe.



LEANING TOWER OF PISA.

Galileo's popularity was mainly with his students and the multitude. His students, indeed, loved him utterly, and some of them in their turn became almost as great and fa-

mous as he was. But with his fellow-professors in the universities, and with all those who thought that science was like a dead language—a domain that might be cultivated but could not be extended—his bold investigations and his original discoveries were far from being acceptable. At Pisa he had propounded the doctrine that all bodies, whether heavy or light, fall with equal velocity; and had demonstrated the doctrine by going up to the top of the famous leaning tower there and letting fall a 100-pound weight and a one-pound weight at the same moment and showing that they reached the ground below at the same moment. But, notwithstanding this demonstration, his fellow-professors would have none of the doctrine. It was contrary to Aristotle's dictum, and to them this was ample proof of its falsity. At Pisa, too, Galileo had become convinced of the truth of the Copernican theory of the construction of the solar system. He had, however, said little about it there, for he had not then been able to add anything to its demonstration. But at Padua he was able by his wonderful invention of the telescope to adduce fact after fact in clinching proof of the Copernican doctrine. He showed that the moon was not a plane reflector, as it was generally supposed to be, but an orb with a rough surface of mountain and valley, precisely like our earth. He showed, too, that the sun was not a simple globe of light, but that it had immense dark spots upon its face, and that these spots had motion, or, in other words, that the sun itself had motion about an axis. He showed, too, that Venus has phases, just as the moon has, a fact which Copernicus had been able to predict, but which he had not been able to demonstrate because he had only his own natural vision to make observations with. Finally Galileo



MILTON VISITING THE AGED GALILEO

discovered that Jupiter has moons—four moons—and was able to prove that these moons revolve around their primary planet just as our moon revolves around our earth. All these facts in confirmation of the Copernican theory Galileo not only demonstrated for himself, but was able by means of the excellent telescopes he made to place within the easy demonstration of others.

But the Copernican theory by this time had come under the ban of the church, and the teachings of Galileo, notwithstanding the physical demonstrations on which they were based, were deemed heretical. Galileo, however, went to Rome about it, and he was so well received there, and his arguments were so favorably listened to, that he thought he had converted the authorities to his views. In this he was sadly deluded. He was a good churchman and a sincere Christian, and he lived a blameless life. Besides, he was noted for his great kindness of heart and his abounding charity. The sympathy of every one, therefore, was with him; but as against what was thought to be fatal error sympathy had no weight. Before he left Rome he was peremptorily forbidden to teach his doctrine further. In 1623, when Urban VIII. came to the pontifical throne—a man of learning, and of interest in education and science—Galileo again went to Rome on the matter. Again he was kindly received, and again he thought he had succeeded in his heart's desire. He went home rejoicing, for he loved his church and was sincerely anxious to do nothing contrary to her will. He at once set to work at his famous book, the "*Dialogues on the Ptolemaic and Copernican Systems.*" No sooner, however, was his great work published than he was summoned to Rome to answer for it. He arrived February, 1633. He was then in his

seventieth year. He was feeble from illness, and broken in mind from worry and anxiety. His trial began almost at once. He was put in the chambers of the inquisition and examined again and again. It is true that he was dealt with in a kindly spirit, but yet with all the rigor that the rules of the inquisition prescribed. He had really no defense. None, indeed, was possible. He had taught and written what he knew to be true, but that which he had taught and written the accusing court declared to be false. It was, therefore, submission and recantation for him, or else torture and death at the stake. His spirit broke. He had always believed in the religious authority of the church; he now acknowledged its authority over his mind and reason. The ignominious recantation and abjuration was drawn up for him, and he solemnly swore to it and signed it—June 22, 1633. He lived nine years more, but no longer free. He was practically a prisoner of the inquisition. In those last sad years, however, he discovered and enunciated the laws of motion which Newton afterward demonstrated so conclusively.

GALILEO GALILEI

SELECTED STUDIES AND REMINISCENCES

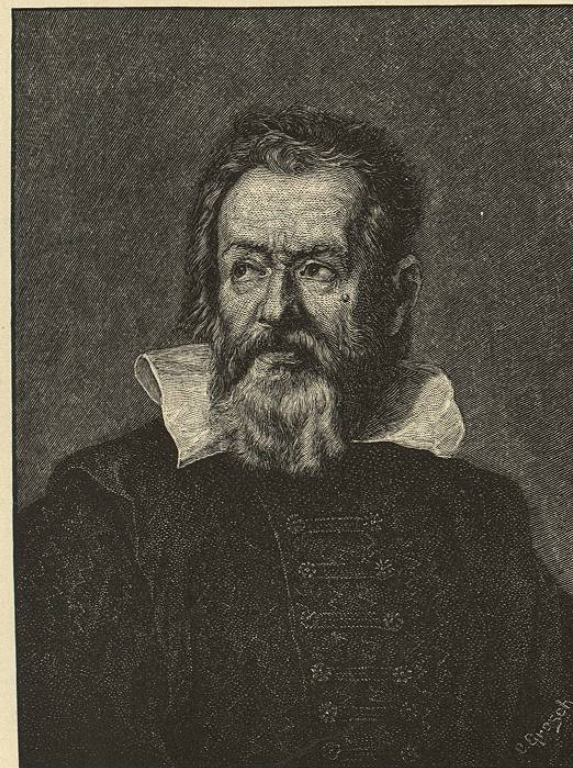
THE DRAMATIC CONTRASTS OF GALILEO'S CAREER

The history of the life and labors of Galileo is pregnant with a peculiar interest to the general reader, as well as to the philosopher. His brilliant discoveries, the man of science regards as his peculiar property; the means by which they were made, and the development of his intellectual character, belong to the logician and to the philosopher; but the triumphs and the reverses of his eventful life must be claimed for our common nature, as subjects of deep interest, and serious meditation.

The lengthened career which Providence assigned to Galileo was filled up throughout its rugged outline with events of even dramatic interest. But though it was emblazoned with achievements of transcendent magnitude, yet his noblest discoveries were the derision of his contemporaries, and were even denounced as crimes which merited the vengeance of Heaven. Though he was the idol of his friends, and the favored companion of princes, yet he became the victim of a cruel persecution, and spent some of his latest hours within the walls of a prison; and though the Almighty granted him, as it were, a new sight,

set forth as true in the writings of the great philosopher Aristotle, whose teachings in all speculative and physical matters were for centuries accepted by the learned of the world as unquestionable. The doctrine therefore had both indisputable intellectual authority and the definite announcements of the church arrayed in its favor, as well as what was supposed to be plain common sense. To doubt it would enter the head of scarcely any one. To hold a different doctrine would be the part only of courageous independent thinkers, of whom in those days there were very few. To teach a different doctrine would be the part only of those who were not afraid to contemplate martyrdom.

The honor of propounding and demonstrating the true theory of the motions of the heavenly bodies—namely, that the sun is the center of a system around which the several planets revolve, that the earth is one of these planets, that the moon likewise is a planet, but also a satellite of the earth, and that the apparent motions of the sun, moon, and stars around the earth are in reality optical illusions caused by the motion of the earth on its own axis—this honor belongs to Copernicus, a learned and observant monk of Prussia. Copernicus was born in 1473, and it was not until he was seventy years old (1543), and on his deathbed, that he published his great work on "The Revolutions of the Heavenly Bodies"—the work that has made his name immortal. Copernicus was a quiet, studious man, very little given to discussion or self-assertion, and the importance of his teachings and demonstrations was scarcely guessed during his lifetime, nor, indeed, until some years after his death. But it was not very long before the "Copernican system," as it was called, began to



GALILEO GALILEI.
Painting by Susterman, Florence.

secure the adherence of bold observers and thinkers, and also to come under the condemnation of that organization for the defense of the faith of the church whose deeds now seem to us to be so cruel—the inquisition. In 1600, for teaching doctrines which were only corollaries from the demonstrations of Copernicus, Giordano Bruno was, after six years of imprisonment, burned at the stake. In 1633, for teaching similar doctrines, Galileo, then an old and feeble man of seventy, was saved from a like awful fate only by a recantation, made, there is but little doubt, through fear of painful torture.

Galileo Galilei, known to fame by his Christian name, Galileo, was born in Pisa, Italy, February 15, 1564. He was thus a contemporary of the English Shakespeare, who was born in the same year. But he lived much longer than Shakespeare, and was in his old age visited by the English Milton. He was the eldest son of a Florentine noble; but his father, though a man of scholarship and refined tastes, was, unfortunately, of impoverished fortune, and was therefore unable to provide for him an education suited to his station and talents. It was at first determined that he should be a cloth merchant. But young Galileo's surpassing ability, his skill in drawing and coloring, his cleverness in devising and making mechanical contrivances, his skill also in music, in which art, indeed, he showed great genius, soon convinced his father that he must be given at least a professional education. He was therefore sent away from Florence, where his father then lived, to the University of Pisa to pursue a course in medicine there. But, though he pursued his studies in medicine for four years, his father was unable to pay the necessary graduation expenses, and so he had to leave the university with-