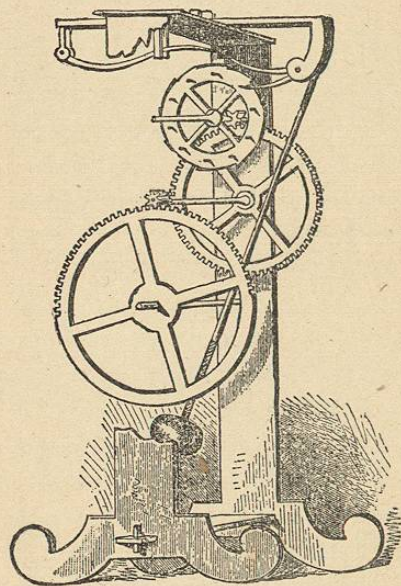


to descry unknown worlds in the obscurity of space, yet the eyes which were allowed to witness such wonders, were themselves doomed to be closed in darkness.

Such were the lights and shadows in which history delineates

“The starry Galileo with his woes.”

But, however powerful be their contrasts, they are not unusual in their proportions. The balance which has been



GALILEO'S PENDULUM.

struck between his days of good and evil, is that which regulates the lot of man, whether we study it in the arbitrary sway of the autocrat, in the peaceful inquiries of the philosopher, or in the humbler toils of ordinary life.—SIR DAVID BREWSTER, in “*The Martyrs of Science*.”

GALILEO'S EARLY YEARS AND EDUCATION

The early years of Galileo were, like those of almost all great experimental philosophers, spent in the construction of instruments and pieces of machinery, which were calculated chiefly to amuse himself and his school-fellows. This employment of his hands, however, did not interfere with the improvement of his mind; and though, from the straitened circumstances of his father, he was educated under considerable disadvantages, yet he acquired the elements of classical literature, and was initiated into all the learning of the times. Music, drawing, and painting were the occupations of his leisure hours; and such was his proficiency in these accomplishments, that he was reckoned a skillful performer on several musical instruments, especially the lute, while his knowledge of pictures was held in great esteem by some of the best artists of his day.—SIR DAVID BREWSTER.

GALILEO, THE MOON, AND THE ARISTOTELIANS

The first celestial object to which Galileo applied his telescope was the moon, which, to use his own words, appeared as near as if it had been distant only two semidiameters of the earth. He then directed it to the planets and the fixed stars, which he frequently observed with “incredible delight.”

The observations which he made upon the moon possessed a high degree of interest. The general resemblance of its surface to that of our own globe naturally fixed his attention; and he was soon able to trace, in almost every part of the lunar disc, ranges of mountains, deep hollows,

entered into an alliance against the philosophical tyrant, who threatened them with the penalties of knowledge.—SIR DAVID BREWSTER.

GALILEO'S CELEBRATED "DIALOGUES"

Having overcome all these difficulties [namely, of publication], Galileo's work appeared in 1632, under the title of "*The System of the World of Galileo Galilei, etc.*" in which, in four dialogues concerning the two principal systems of the world—the Ptolemaic and the Copernican—he discusses, indeterminately and firmly, the arguments proposed on both sides." The dialogue is conducted by three persons—Salviati, Sagredo, and Simplicio. Salviati, who is the true philosopher in the dialogue, was the real name of a nobleman and friend of Galileo. Sagredo, the name of another noble friend of Galileo, performs a secondary part under Salviati. He proposes doubts, suggests difficulties, and enlivens the gravity of the dialogue with his wit and pleasantry. Simplicio is a resolute follower of Ptolemy and Aristotle, and, with a proper degree of candor and modesty, he brings forward all the common arguments in favor of the Ptolemaic system. Between the wit of Sagredo, and the powerful philosophy of Salviati, the peripatetic sage is baffled in every discussion; and there can be no doubt that Galileo aimed a more fatal blow at the Ptolemaic system by this mode of discussing it, than if he had endeavored to overturn it by direct argument.—SIR DAVID BREWSTER.

THE GREAT TRIAL

Worn out with age and infirmities, and exhausted with

the fatigues of his journey, Galileo arrived at Rome on the 14th of February, 1633. During the whole of the trial which had now commenced, Galileo was treated with the most marked indulgence. Abhorring, as we must do, the principles and practice of this odious tribunal, and reprobating its interference with the cautious deductions of science, we must yet admit that, on this occasion, its deliberations were not dictated by passion, nor its power directed by vengeance. Though placed at their judgment seat as a heretic, Galileo stood there with the recognized attributes of a sage; and though an offender against the laws of which they were the guardians, yet the highest respect was yielded to his genius, and the kindest commiseration to his infirmities.

In the beginning of April, when his examination in person was to commence, it became necessary that he should be removed to the Holy Office; but instead of committing him, as was the practice, to solitary confinement, he was provided with apartments in the house of the fiscal of the Inquisition. His table was provided by the Tuscan Ambassador, and his servant was allowed to attend him at his pleasure, and to sleep in an adjoining apartment. Even this nominal confinement, however, Galileo's high spirit was unable to brook.

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Having duly weighed the confessions and excuses of their prisoner, and considered the general merits of the case, the Inquisition came to an agreement upon the sentence which they were to pronounce, and appointed the 22nd of June as the day on which it was to be delivered. On the 22nd of June Galileo was clothed

in a penitential dress, and conducted to the Convent of Minerva, where the Inquisition was assembled to give judgment. A long and elaborate sentence was pronounced, detailing the former proceedings of the Inquisition, and specifying the offenses which Galileo had committed in teaching heretical doctrines, in violating his former pledges, and in obtaining by improper means a license for the printing of his Dialogues. After an invocation of the name of our Saviour, and of the Holy Virgin, Galileo is declared to have brought himself under strong suspicions of heresy, and to have incurred all the censures and penalties enjoined against such delinquencies; but from all these consequences he is to be held absolved, provided that, with a sincere heart and faith unfeigned, he abjures and curses the heresies he has cherished, as well as every other heresy against the Catholic Church. In order that his offense might not go altogether unpunished, that he might be more cautious in future, and be a warning to others to abstain from similar offenses, it was also decreed that his Dialogues should be prohibited by public edict, and that he himself should be condemned to the prison of the Inquisition during its pleasure.—SIR DAVID BREWSTER.

THE ABJURATION

The ceremony of Galileo's abjuration was one of exciting interest, and of awful formality. Clothed in the sackcloth of a repentant criminal, the venerable sage fell upon his knees before the assembled cardinals; and laying his hands upon the Holy Evangelists, he invoked the Divine aid in abjuring and detesting, and vowing never again to teach the doctrine of the earth's motion, and of the

sun's stability. He pledged himself that he would never more, either in words or in writing, propagate such heresies; and he swore that he would fulfil and observe the penances which had been inflicted upon him. At the conclusion of this ceremony, in which he recited his abjuration, word for word, and then signed it, he was conveyed, in conformity with his sentence, to the prison of the Inquisition.—SIR DAVID BREWSTER.

GALILEO'S BLINDNESS

Every relaxation of Galileo's misery excited the malice of his enemies; secret denunciations of his influence were poured into Rome, and kept him in constant fear. Then his favorite daughter died. Yet he roused himself out of even this misfortune, and wrote his work on the laws of motion. At last his final misery overtook him. He was attacked by a disease of one eye, which slowly darkened, and then the other began to fail, and at last he was quite blind. "This heaven, this earth," he wrote, "this universe, which with wonderful observations I had enlarged a hundred, a thousand times beyond the belief of bygone ages, henceforth for me is shrunk into the narrow space which I myself fill in it. So it pleases God; it shall therefore please me also."—E. J. C. MORTON, B. A., in "*Heroes of Science—Astronomers.*"

GALILEO'S GREATNESS

The scientific character of Galileo, and his method of investigating truth, demand our warmest admiration. The number and ingenuity of his inventions, the brilliant discoveries which he made in the heavens, and the depth and

beauty of his researches respecting the laws of motion, have gained him the admiration of every succeeding age, and have placed him next to Newton and Kepler in the lists of original and inventive genius. To this high rank, he was doubtless elevated by the inductive processes which he followed in all his inquiries. Under the same guidance of observation and experiment, he advanced to general laws; and if Bacon had never lived, the student of nature would have found, in the writings and labors of Galileo, not only the boasted principles of the inductive philosophy, but also their practical application to the highest efforts of invention and discovery.—SIR DAVID BREWSTER.

READERS' AND STUDENTS' NOTES

1. Accounts of Galileo are given in almost every handbook of the history of science and in almost every handbook of scientific biography, for Galileo is a great name in science, and the story of his life is fascinating. A very readable account of him is given in Sarah K. Bolton's "*Famous Men of Science*" (New York: T. Y. Crowell & Co., \$1.50), a work that also gives accounts of Newton, Cuvier, Herschel, Humboldt, Davy, Audubon, Lyell, Agassiz, and Darwin, on our list, besides several other "famous men of science." The work is illustrated with numerous portraits.

2. The student who wishes to know something more about Galileo than his biography will find in "*Heroes of Science—Astronomy*" (London: The S. P. C. K. New York: E. & J. B. Young & Co.) by E. J. C. Morton, B. A., not only his biography, but also a readable account of his discoveries and scientific work generally. This work is essentially a history of astronomy, written for the general reader. Besides an account of the life and work of Galileo, it contains accounts of the lives and works of

Copernicus, Tycho Brahe, Kepler, Newton, Lagrange, Laplace, and Herschel.

3. One of the most distinguished students of the nineteenth century was Sir David Brewster. One of his works was "*The Martyrs of Science*," or "*The Lives of Galileo, Tycho Brahe, and Kepler*." Students who wish a somewhat longer and more minute account of Galileo than those which the foregoing works give, but one that is perfectly readable, even by those who do not understand mathematics, will find the sketch of Galileo in this book eminently instructive and entertaining. The book is all the more valuable because of its similar accounts of the lives and works of Tycho Brahe and Kepler.

4. One of the most useful works that a young student can possibly have is Arabella B. Buckley's work, entitled "*A Short History of Natural Science and of the Progress of Discovery from the Time of the Greeks to the Present Time*." (New York: D. Appleton & Company, \$2.00.) It is prepared especially for the use of the general reader, and is quite intelligible not only to those who do not understand mathematics, but also to those whose education in any branch of science is only elementary. Its great merit is that it is not only thoroughly sound and scientific, but also exceedingly readable and interesting. The student will find it helpful to him in his study not only of Galileo, but also of almost every other of the "World's Great Scientists" on our list.

and other inequalities, which reverberated from their summits and margins the rays of the rising sun, while the intervening hollows were still buried in darkness. The dark and luminous spaces he regarded as indicating seas and continents, which reflected, in different degrees, the light of the sun, and he ascribed the phosphorescence, as it has been improperly called, or the secondary light, which is seen on the dark limb of the moon in her first and last quarters, to the reflection of the sun's light from the earth.

These discoveries were ill received by the followers of Aristotle. According to their preconceived opinions, the moon was perfectly spherical and absolutely smooth; and to cover it with mountains, and to scoop it out into valleys, was an act of impiety which defaced the regular forms which Nature herself had imprinted. It was in vain that Galileo appealed to the evidence of observation, and to the actual surface of our own globe.—SIR DAVID BREWSTER.

GALILEO PROVES THAT THE EARTH IS NOT THE CENTER OF THE UNIVERSE

The importance of this great discovery [of the moons of Jupiter] was instantly felt by the enemies, as well as by the friends, of the Copernican system. The planets had hitherto been distinguished from the fixed stars only by their relative change of place, but the telescope proved them to be bodies so near to our own globe as to exhibit well-defined discs, while the fixed stars retained, even when magnified, the minuteness of remote and lucid points. The system of Jupiter, illuminated by four moons, performing their revolutions in different and regular pe-

riods, exhibited to the proud reason of man the comparative insignificance of the globe he inhabits, and proclaimed in impressive language that that globe was not the center of the universe.—SIR DAVID BREWSTER.

GALILEO, KEPLER, AND THE PROFESSOR OF PHILOSOPHY OF PADUA

The reception which these discoveries [of the moons of Jupiter, etc.] met with from Kepler is highly interesting, and characteristic of the genius of that great man. He was one day sitting idle, and thinking of Galileo, when his friend Wachenfels stopped his carriage at his door, to communicate to him the intelligence. "Such a fit of wonder," he says, writing to Galileo, "seized me at a report which seemed to be so very absurd, and I was thrown into such agitation at seeing an old dispute between us decided in this way, that between his joy, my coloring, and the laughter of both, confounded as we were by such a novelty, we were hardly capable, he of speaking, or I of listening."

In a very different spirit did the Aristotelians receive the "Sidereal Messenger" of Galileo. The principal professor of philosophy at Padua resisted Galileo's repeated and urgent entreaties to look at the moon and planets through his telescope; and he even labored to convince the Grand Duke that the satellites of Jupiter could not possibly exist. Sizzi, an astronomer of Florence, maintained that as there were only *seven* apertures in the head—*two* eyes, *two* ears, *two* nostrils, and *one* mouth—and as there were only *seven* metals, and *seven* days in the week, so there could be only *seven* planets. He seems, however, to have admitted the visibility of the four satellites through

the telescope; but he argues, that as they are invisible to the naked eye, they can exercise no influence on the earth; and being useless, they do not therefore exist.—SIR DAVID BREWSTER.

GALILEO'S FIRST VISIT TO ROME

Galileo had long contemplated a visit to the metropolis of Italy, and he accordingly carried his intention into effect in the early part of the year 1611 [when he was forty-seven years old]. Here he was received with that distinction which was due to his great talents and his extended reputation. Princes, cardinals, and prelates hastened to do him honor; and even those who discredited his discoveries, and dreaded their results, vied with the true friends of science in their anxiety to see the intellectual wonder of the age.

In order to show the new celestial phenomena to his friends in Rome, Galileo took with him his best telescope; and as he had discovered the spots on the sun's surface in October or November, 1610, or even earlier, he had the gratification of exhibiting them to his admiring disciples. He accordingly erected his telescope in the Quirinal garden belonging to Cardinal Bandini; and in April, 1611, he showed the spots to his friends in many of their most interesting variations. From their change of position on the sun's disc, Galileo had inferred that the sun revolved about an axis. He found that the spots must be in contact with the surface of the sun—that their figures were irregular—that they had different degrees of darkness—that one spot would often divide itself into three or four—that three or four spots would frequently unite themselves into

one—and that all the spots revolved regularly with the sun, which appeared to complete its revolution in about twenty-eight days.—SIR DAVID BREWSTER.

GALILEO'S IMPETUOUS ARDOR

The ardor of Galileo's mind, the keenness of his temper, his clear perception of truth, and his inextinguishable love of it, combined to exasperate and prolong the hostility of his enemies. When argument failed to enlighten their judgment, and reason to dispel their prejudice, he wielded against them the powerful weapons of ridicule and sarcasm; and in this unrelenting warfare, he seems to have forgotten that Providence had withheld from his enemies the intellectual gifts which he had so liberally received. He who is allowed to take the start of his species, and to penetrate the veil which conceals from common minds the mysteries of nature, must not expect that the world will be patiently dragged at the chariot-wheels of his philosophy. Mind has its inertia as well as matter; and its progress to truth can only be insured by the gradual and patient removal of the difficulties which embarrass it.

The boldness—may we not say the recklessness—with which Galileo insisted upon making proselytes of his enemies, served but to alienate them from the truth. Errors thus assailed speedily entrench themselves in general feeling, and become embalmed in the virulence of the passions. The various classes of his opponents marshalled themselves for their mutual defense. The Aristotelian professors, the temporizing Jesuits, the political churchmen, and that timid but respectable body who at all times dread innovation, whether it be in legislation or in science,