THE LIFE

OF

SIR ISAAC NEWTON.

"——— Newton, child-like sage!
Sagacious reader of the works of God,
And in His word sagacious."

COWPER'S TASK.

PHILADELPHIA:
AMERICAN SUNDAY-SCHOOL UNION,
NO. 146 CHESTNUT STREET.

LONDON:
RELIGIOUS TRACT SOCIETY.

First printing: January 2014

For information write:
New Leaf Publishing Group, P.O. Box 726, Green Forest, AR 72638.
Attic Books is a division of the New Leaf Publishing Group, Inc.

ISBN-13: 978-0-89051-796-3

Library of Congress Number: 2013956459

Printed in the United States of America

Please visit our website for other great titles: www.nlpg.com

Originally published in 1907 by the American Sunday-school Union (ASSU) in partnership with the London Religious Tract Society. With its roots in the latter part of the 1700s, the ASSU, now called InFaith, sent missionaries with books published by the mission to leave with fledgling Sunday schools they had started, promoting literacy, education, and the very best in Christian moral values.

Publisher's note: In order to preserve the historical nature of this work, the British spellings and formatting of the text have been carefully reproduced as they were in the original book.

CONTENTS.

CHAPTER I.

PAGE

Eminent men in science during the sixteenth and seventeenth centuries—Birth of Newton—Youthful promise—Grantham school—Scientific amusements . . . 5

CHAPTER II.

Admission to Trinity College—Degrees—Lucasian professor of mathematics—Experiments—Discovery of the composition of light—Construction of telescopes—Optical lectures—Fellow of Royal Society—Controversies—Theory of colours—Theory of light—Optics . . 22

CHAPTER III.

Newton's earliest speculations on gravity—Law of gravitation discovered—THE PRINCIPIA—Progress of Newton's philosophy in England and on the continent of Europe 36

CHAPTER IV.

Mathematical studies—The Binomial Theorem—Fluxions—Universal arithmetic—Differential method—Geometrical analysis—Problems of Bernouilli and of Leibnitz—Controversy respecting the discovery of fluxions . . 47

CHAPTER V.

Newton's public life—James II. and the University of Cambridge—Newton in parliament—Appointed Warden of the Mint—Favour at court—Republication of the "Principia"—Works on chronology 51

CONTENTS

CHAPTER VI.

PAGE

Newton's chemical studies—Heat—Fire—Flame—Elective attraction—Structure of bodies—Ether—Electricity—Inventions—Experiments with the retina 71

CHAPTER VII.

Sir Isaac Newton's views of Theology 80

CHAPTER VIII.

The illness and supposed mental derangement of Newton 101

CHAPTER IX.

Newton's connexion with the Royal Society 105

CHAPTER X.

Newton's personal appearance—Private and social habits—Last illness—Death—Funeral—Monuments . . 132

CHAPTER XI.

The intellectual superiority of Newton—His rigid method of inquiry—The magnificence of the results—The true position of Newton among philosophers—Testimonies to his fame 145

CHAPTER XII.

Lessons taught by the life of sir Isaac Newton—To the young—To parents—To Christians—To the lovers of science 167

LIFE

OF

SIR ISAAC NEWTON.

CHAPTER I.

Eminent men in science during the sixteenth and seventeenth centuries—Birth of Newton—Youthful promise—Grantham school—Scientific amusements

THE interest which has belonged to the name of Newton throughout the civilized world for nearly two hundred years, is built on foundations so solid, that no person can be regarded as even tolerably well informed, who has not some acquaintance with the works of this most illustrious of natural philosophers. An exact acquaintance with those works must ever be confined to the learned few; by them they are always esteemed in proportion to the extent and accuracy of their own acquirements in those departments of science to which Newton has added so much lustre.

We purpose, in this volume, to present a continuous narrative of the chief occurrences in Newton's life, and such an account of his mental labours, his discoveries, and his writings, as may both amuse and instruct the reader.

It will be difficult to understand what Newton was, and what he did, without having before us a general idea of the state of science when he appeared, especially the discoveries which had been made in astronomy and in optics. It will materially aid us, also, to have some familiarity with the other philosophers of the same age, with whom it is fair to compare Newton, and who were useful to him, either in encouraging his early studies, in bringing him out from the retirement to which his modesty would have confined him, or in calling the attention of the scientific world to his extraordinary inventions and productions.

ROGER BACON, the light of England in the thirteenth century, had astonished his fellow-countrymen with *suggestions* in physical science, to be fully carried out in succeeding generations; and the labours of not a few continental scholars had extended a portion of their fame to the more cultivated minds in this nation.

In the sixteenth century, COPERNICUS, born at Thorn in Prussia, abandoned the pursuit of me-

dicine, to study astronomy with Dominic Maria at Bologna, and afterwards to teach mathematics in Rome. Copernicus was nephew to the bishop of Ermeland, who made him a canon of the cathedral at Frauenberg. While carrying on his astronomical observations in a house well situated on the brow of a hill, he devoted a large portion of his time to the examination of ancient opinions on the system of the universe. After comparing the various schemes for thirty years, he reached the discovery that *the sun is the centre of our system.* This great truth, and others connected with it, he established in his "Revolutions of the Heavenly Bodies." Slowly and cautiously he overturned the established opinions of mankind. Nine years after the writing of his book, he was prevailed on by George Rheticus, mathematical professor at Wirtemberg, to allow him to publish some account of his system, and his own work was printed at Nuremberg. A complete copy was handed to him in his last moments, and he saw and touched it a few hours before his death.*

Three years after Copernicus died, TYCHO BRAHE, of a Swedish family, was born at Knudstorp, in Norway. At the age of fourteen, while a student at Copenhagen, an eclipse of

* Brewster's Life of Newton, p. 118.

the sun, which had been predicted, engaged his attention, and he was filled with an insatiable thirst for so infallible a science. To escape the reproaches and even persecutions which his new studies brought upon him, he left Denmark to travel in Germany. At Rostock he encountered a Danish nobleman, like himself a mathematician, but, like himself, also, of hasty temper, and they agreed to determine a dispute in geometry by an appeal to the sword! Tycho lost the greater part of his nose in the duel. At Augsburg, Peter Hainzell, the *burgomeister* of the city, built an observatory, where the Danish astronomer laid the foundations of his imperishable fame. In a few years, he was received at court by the king of Denmark, honoured by all ranks, and encouraged to the utmost in the prosecution of his studies; there he had the remarkable advantage of observing the new star in Cassiopeia, which was visible for many months, even in the daytime. From Denmark Tycho removed to Basle; but his sovereign induced him, by extraordinary munificence, to return, and for twenty years he continued to enlarge the boundaries of science at Uranibourg. The observatory in which he carried on his observations cost the king about £20,000. In this royal retreat he was visited by James I. of

England who paid him the highest compliments in his power. Tycho was an *observer*, not a philosophical reasoner. He rejected the system of Copernicus. The death of his sovereign left Tycho at the mercy of his enemies at court, and he was driven with his wife and children into exile. At Prague, he enjoyed the protection and the bounty of the emperor Rodolph II.

The agonies of Tycho's dying bed were soothed by the conversation of his illustrious disciple, JOHN KEPLER. Kepler was born at Wiel, in Wirtemberg, in 1571. His earlier days were spent in the service of the church; but he was little more than twenty-three years old when he was called to the mathematical chair at Gratz, in Styria. In two years, he published a speculative work. It was condemned by Tycho Brahe, who advised him to *begin his philosophy with observation.* He succeeded his master in the favour of the emperor, and continued to enjoy the imperial patronage of Rodolph's successors, Matthias and Ferdinand. Tycho had discovered the *variation* of the moon's motion, her annual *equation*, and the *inclinations* of her orbit. Kepler came into the possession of Tycho's invaluable observations; and while trying, by their means, the theory of the uniform circular motion of the planets, he arrived

at the discovery, that "Mars revolves round the sun, *not* in a circular, but in an *elliptical* orbit." He also made, by means of these observations, the equally important discovery in physical astronomy — that "the radius vector describes equal areas in equal times." These discoveries were gradually established as including all the other planets in the solar system, and they were published in Kepler's "Commentaries on the Motions of the Planet Mars, as deduced from the Observations of Tycho Brahe." After much fruitless speculation, and many anxious but erroneons calculations, he discovered the great law, "that the squares of the periodic times of any two planets are to one another as the cubes of their distances from the sun." When he made this discovery, he says, he at first believed that he was dreaming, and had taken for granted the very truth of which he was in search. The work in which he published it, "Harmony of the World," was dedicated to James VI. of Scotland.

These are the celebrated "Three Laws of Kepler :"—(1) "The motion of the planets in elliptical orbits; (2) the proportion of the areas described, with the *time* in which they are described; (3) the relations of the *squares* of the periodic times to the *cubes* of the distances."

Kepler's active mind propounded many sagacious *conjectures* respecting the sun as the centre of gravitation, the reciprocal law of gravitation itself, and its effect on the tides and on the irregularities of the moon's motions.

Contemporary with Kepler, but in another country, was GALILEO, a native of Pisa, and professor of mathematics at Padua. He had attained his forty-fifth year before he distinguished himself as an astronomical discoverer. The year in which Kepler published his "Commentary," Galileo was at Venice, where he heard of a new instrument for celestial observations. Without seeing it, he discovered the principle on which it was made. He then constructed one for himself, which, by subsequent experiments, he gradually improved into a telescope of sufficient power to "show things almost a thousand times larger, and above thirty times nearer to the naked eye."

The discoveries which this magnificent invention opened to Galileo were most brilliant. The four satellites of Jupiter were observed. A new analogy to our own planet was established. The path of Venus round the sun was traced in its varying phases. The rotation of the sun was deduced from the spots seen upon his disc. Mountains were beheld in the moon, and

her *libration* was ascertained. Portions of the ring of Saturn were observed. Stars in the Milky Way were proved to be at immeasurable distances, from their not being magnified by the telescope. The great system of Copernicus, according to which the planets move around a central sun, was established beyond controversy.

In the plenitude of his success and of his reputation, Galileo naturally expected that the system which Copernicus had made public, with the highest sanctions of the church, would be universally embraced by all lovers of truth, and especially by Christians. But he was deceived. In that liberal age—when the light of science was banishing from the mind of Europe so many errors of past times; when the light of Divine truth was unveiled by the Reformers; when the doctrine of *salvation by faith in Jesus Christ without the deeds of the law*, was eagerly embraced by thousands in the northern nations —in that very age, the most enlightened Roman Catholic in the world was cited before "the Holy Inquisition," on a charge of heresy! He was accused of "maintaining as true the *false* doctrine held by many, that the sun was immovable in the centre of the world, and that the earth revolved with a diurnal motion; of

having certain disciples, to whom he taught the same doctrine; of keeping up a correspondence on the subject with several *German* mathematicians; of having published letters on the solar spots, in which he explained the same doctrine as true; and of having glossed over, with a false interpretation, the passages of Scripture which were urged against it." These "false opinions" he was required to renounce altogether, or be cast into prison. In the presence of the great cardinal Bellarmine, Galileo promised obedience, and he was dismissed. But six years had not passed away before he published his "Cosmical System; or, Dialogues on the two great Systems of the World, the Ptolemean and the Copernican." The Inquisition saw that the obnoxious doctrines were gaining ground, and they summoned the venerable philosopher, now bending beneath the weight of seventy years, to answer for his disobedience. They condemned him to the prison of the Inquisition, *during pleasure*, and to the weekly recital of the seven penitential psalms for three years. The poor old man degraded himself, and dishonoured the God of truth, by signing an abjuration, and on his knees, with his right hand on the Gospels, he cursed the truths which God had honoured him to teach. If it be true,

as we are told, that, on rising from his knees, he said, "It does move, though," our sorrow is only the deeper, that so great a teacher should have been so moved by fear, or by superstition, to belie his conscience; while we are forced to express, as calmly as we may, our detestation of the tyrannous hypocrisy of a church which would demand the sacrifice, or accept it.

The Inquisition, however, had not all its own way. The Copernican system was expounded and defended by a Carmelite monk, under the sanction of a pious nobleman of Naples. Galileo, indeed, lay, unpitied by "the master spirits of the age," in the cell of the Inquisition. His imprisonment was relieved and shortened through the influence of the grand duke of Tuscany, and other illustrious courtiers. Broken by disease and by domestic sorrow, the last use he made of his failing sight was to observe the interesting astronomical phenomenon of the moon's *libration*, which he partially explained. His last days were comforted by some relaxation in the rigour of his punishment. Nearly deaf, and totally blind, he was seized with palpitation and fever, while actively studying the forces of percussion. After a few weeks of illness, he died, at the age of seventy-eight, in the same year in which Newton was born.

Other names deserve to be recorded among the precursors of Newton in astronomical discovery. These were troublous times in England. "Yet, under circumstances so unpropitious, it is instructive to contemplate the picture presented to us, of a small band of philosophers struggling against every disadvantage, pursuing their researches in seclusion, obscurity, and neglect." There was William Millbourne, in the village of Brancepeth, near Durham, a humble curate, detecting errors in the best astronomical tables then existing. There was W. Gascoyne, a young country gentleman, of Middleton, in Yorkshire, (who was killed in the battle of Marston Moor,) the inventor of the invaluable *micrometer*. There was Crabtree, at Broughton, near Manchester. There was Horrox, "in the rural hamlet of Toxteth, near a small seaport town in Lancashire, called Liverpool," struggling through poverty and neglect to Emanuel College, Cambridge, and returning to his native county, to observe, *for the first time* by man, the transit of Venus over the sun's disc, while a hard-working curate, on a "poor pittance," at Hool, near Preston—a man of the highest order of genius. There was William Oughtred, fellow of King's College, and rector of Albury, "the mathematical oracle of his day."

In those disturbed times, Wilkins, Boyle, Wallis, Seth Ward, and their scientific associates, formed a philosophical society, first in London, and then in Oxford. JOHN FLAMSTEAD, a sickly lad at Derby, was employing his forced leisure in those unassisted studies of astronomy which have done so much to unveil the stars, and to make the ocean the high road of nations. Bouillard, in France, wrote the precious sentence, that "if attraction existed, *it would decrease as the square of the distance.*" At Naples, Borelli wrote a volume, to prove that the planets perform their motions round the sun *according to a general law*. Dr. Hooke instructed the Royal Society in the outline of the great comprehensive truth which it was the glory of Newton to *simplify* and *to demonstrate.**

ISAAC NEWTON was the only son of Isaac Newton and Harriet Ayscough. He was born on the 25th December, (o.s.) 1642, at the manor-house of Woolsthorpe, in the parish of Colsterworth, six miles south of Grantham, in Lincolnshire. The Newtons appear to have been anciently a Lancashire family, where

* Historical Essay on the first publication of Sir Isaac Newton's Principia. By Professor Rigaud.—Correspondence of Scientific Men of the Seventeenth Century.—Sir Isaac Newton and his Contemporaries. Edinburgh Review, No. cxlviii.

the name of the place, either taken or given by them, still remains. The house at Woolsthorpe was repaired about fifty years ago by the proprietor, Mr. Turner, of Stoke Rocheford, the author of "Collections for the History of the Town and Stoke of Grantham;" and in the chamber where Newton was born he placed a white marble tablet, with this inscription:—

"Sir Isaac Newton, son of John Newton, lord of the manor of Woolsthorpe, was born in this room, on the 25th December, 1642.

"'Nature and Nature's laws lay hid in night;
God said, "Let Newton be," and all was light.'"

The following lines have been written upon the house:—

"Here Newton dawned, here lofty wisdom woke,
And to a wondering world divinely spoke.
If Tully glowed, when Phædrus' steps he trod,
Or Fancy formed Philosophy a god—
If sages still for Homer's birth contend,
The sons of science at this dome must bend.
All hail the shrine! all hail the natal day!
Cam boasts his noon—this COT his morning ray."*

This child was born after his father's death. As an infant, he was remarkable for his extreme smallness and delicacy. His mother cherished him with tender anxiety on the paternal estate, which, together with a property of her own, three miles distant, at Sewstern, in Leicestershire, was of the value of eighty pounds a year.

* Sir David Brewster's Life of Newton, pp. 343, 344.

When Isaac was three years old, Mrs. Newton was married to the reverend Barnabas Smith, rector of North Witham, near Woolsthorpe. From that time, the child was committed to the charge of his maternal grandmother. After acquiring the rudiments of education at the day schools of Skillington and of Stoke, he was placed, in his twelfth year, at the public school in Grantham, then taught by Mr. Stokes, and he lived in the house of Mr. Clarke, apothecary, of Grantham. His own confessions represent him as somewhat idle, and far behind his compeers, until he received a severe kick from the boy immediately above him, when he resolved to rise to the head of the school, and attained the object of his ambition by the habit of close application to study which he never abandoned. His amusements were not those of his companions. He procured a number of saws, hammers, hatchets, and such other mechanical tools as he could handle, and soon learned to use them with great skill. He made a carriage, to be moved by the person sitting in it. He contrived a clock, which marked the time exactly by the falling of water. A peculiar kind of windmill was built near the road from Grantham to Gunnerby; during its erection, Newton had watched the workmen so carefully, that he

soon produced a model of it, which was seen at work on the top of Mr. Clarke's house, and was greatly admired. The ingenious contriver shut up a mouse in his little mill, calling it his *miller*. This industrious miller moved the machine, and ate up the flour. To divert his school-mates, Newton manufactured paper kites on the best scientific principles. In the dark mornings of winter, he carried with him paper lanterns, and at night he alarmed the ignorant neighbours with the dread of comets, by tying the lanterns to the tails of kites. He covered the walls of his apartment with mathematical figures, drawings from nature, or copies from designs. Some of these he had framed. Under a portrait of king Charles I. were some verses, believed to have been written by Newton himself:

"A secret art my soul requires to try,
If prayers can give me what the wars deny.
Three crowns, distinguished here, in order do
Present their objects to my knowing view.
Earth's crown thus at my feet I can disdain,
Which heavy is, and at the best but vain.
But now a crown of thorns I gladly greet;
Sharp is this crown, but not so sharp as sweet.
The crown of glory that I yonder see,
Is full of bliss and of eternity."

It is not unlikely that the imperfections which the young philosopher detected in his water-clock led him to pay more attention to the sun, whose apparent motions he marked out

by pegs, which he placed at such distances as gave the hours and half-hours. It is related that, in the house where he lodged while at school, Newton was happy in the society of some young ladies, for whose convenience and gratification it was a pleasure to turn his mechanical ingenuity to account. With one of these ladies, his junior by two or three years, Miss Storey, who was afterwards twice married, he cultivated a lively friendship. This lady lived at Grantham to the age of eighty-two, and, after the death of Newton, communicated many interesting particulars of his early life to Dr. Stukely. These were published by Turner, in his "Collections for the History of the Town and Stoke of Grantham."

Newton's mother again became a widow, having had three daughters by the rector of North Witham. Leaving the rectory, she returned to the manor of Woolsthorpe, and recalled her son from Grantham to help her in the management of their little farm. He was now fifteen years old. He was regularly sent to the market at Grantham to dispose of their produce, and to make the purchases needed in the family. A trusty servant accompanied him on these occasions. When they had put up their horses at the Saracen's Head, Newton

left the business to the servant, repaired to his old lodgings, and pursued his studies till the evening. Sometimes he did not go to Grantham at all, but occupied himself with his own thoughts in the shade of a hedge-row, until his faithful companion rejoined him on his return from market. "The more immediate affairs of the farm were not more prosperous under his management than would have been his marketings at Grantham. The perusal of a book, the execution of a model, or the superintendence of a water-wheel of his own construction, whirling the glittering spray from some neighbouring stream, absorbed all his thoughts when the sheep were going astray, and the cattle were devouring or treading down the corn." *

Mrs. Smith now perceived that the capacities, attainments, and habits of her son, were such as to encourage her to secure for him all the culture within his reach. She sent him back to Grantham school, where he spent several months in ardent study. His maternal uncle, the rector of a neighbouring parish, who had studied at Trinity College, Cambridge, persuaded him to enter the same society, to which it was finally resolved that he should proceed at the following term.

* Sir David Brewster's Life of Newton, p. 10.