

## Newton by Leo Rosten

<sup>1</sup>1665. THE BUBONIC PLAGUE raged in England. Cambridge sent all students home—among them one Isaac Newton, a silent, humorless young man who had no friends, was not interested in girls, often dressed freakishly, was hopelessly lost in his thoughts. He returned to his mother's house now, aged 23, with nothing to do except wait for Cambridge to reopen. Nothing to do? In the next eighteen months, he made three of the greatest discoveries in the history of human thought.

<sup>2</sup>Sitting in the garden one day, he saw an apple fall to the ground...Stop. Newton did not “discover” gravitation. Learned men accepted the idea of gravity, but assumed it was limited to a certain small distance above the earth. More important, no one had *proved* that gravitation exists. Newton's great stroke of imagination was to ask: Could it be that the invisible force that had pulled the apple off the branch was the same force that keeps the moon in its orbit? Could it be that the earth not only “attracts” the moon, but reaches out beyond its highest mountains, far, far into space? Do the earth, moon, planets, satellites whirl around the sun, bound by the sun's gravitation? Is gravity found in *matter* itself—any piece of matter? Does the apple attract the earth, too, however infinitesimally? Is gravitation an invisible binding power which holds the entire *universe* together? If gravity is such a force, he speculated, it can be measured. And if it can be measured, the entire solar system could be reduced to one mathematical formula! Newton quickly made some calculations; the results were only “pretty nearly correct.” (He learned 18 years later that his figure for the earth's radius was inaccurate.)

<sup>3</sup>And why, young Newton wondered, did the apple fall *straight* down? Why didn't the apple fall slightly to one side? (The earth, after all, always spins on its axis.) Could it be that objects are drawn not to the earth's surface—but toward the earth's *center*? He had the astounding idea that the gravitational pull of any body (diminished with distance, varying according to size and density) acts *as if all of its mass* is magically compressed, *concentrated in a single point* at the center. The earth, the moon, the sun itself could be treated as *points* in space! The mathematics of the day was too crude to work out the incredibly complex problems. So he improved it—and created the differential and integral calculus, as ingenious a device as ever came from a mortal mind. It is the basis of all modern mathematics.

<sup>4</sup>Newton, believe it or not, now put all his theories, notes, formulas aside and turned to a new problem: light. He made a small hole in the window blind and directed a beam of sunlight so that it hit a small triangular glass, passed through this prism and hit a screen, where it appeared not as a spot of white, but in a rectangle of colors: violet at the top, then blue, green, yellow, orange, red. Each color had been bent (“refracted”) in the glass prism at a different angle—and the colors differed in their “length,” from glass to screen (violet longest, red shortest). Newton called this rectangular band a “spectrum.” He then placed a second glass triangle so that the colors emerging from the first prism passed through the second—and, to his astonishment, the colors emerged, reblended as white! It was a startling discovery, for white light had always been considered “absolute.” The paper he published founded the science of optics.

(He also made the first reflecting telescope.)

<sup>5</sup>For 13 years, Newton published nothing about universal gravitation or calculus. He worked on the *Philosophiae Naturalis Principia Mathematica* (“The Mathematical Principles of Natural Philosophy”) with such ferocious concentration that he suffered a nervous breakdown. He lost his “former consistency of mind,” wrote abusive letters to friends. The *Principia*, the greatest single feat of analysis in all science, created a furor. It defined mass, force, inertia. It established the laws of motion. It observed that every action has an equal reaction: “If you press a stone, [your] finger is also pressed by the stone.” It calculated the mass of the sun. It explained the moons “perturbed” orbit. It proved that the earth bulges around the equator slightly flattened. It showed that the moon’s pull causes the earth’s axis to inscribe a circle in space, and explained why the equinoxes take place a little earlier each year. It explained the mystery of the tides, the sea’s surging response to the pull of moon and sun. It even explained comets, which astronomers thought moved “lawlessly” and represented God’s warnings to men: Newton predicted their movements with beautiful precision. One comet appeared exactly on schedule.

<sup>6</sup>Newton pushed theology out of science. He gave men a model of how to understand nature, how to experiment, how to let theories flow from facts—not faith. He created a new cosmology—one that completely replaced the mystical universe of the Middle Ages. He transformed astronomy into a branch of physics. He made mathematics the key to the secrets of the universe.

<sup>7</sup>He was attacked for the outrageous notion that the universe could be reduced to numbers. Newton had removed God

from the universe, many said, replaced His glories with a soulless machine, debased creation into “the lifeless story of a planless mind.” Newton, a pious man, was horrified. In the *Principia*, he had written: “This most beautiful system... could only proceed from the...dominion of an intelligent and powerful Being.”

<sup>8</sup>Scientists scoffed at the absurd idea that objects “attract” one another from a distance, with no physical contact or intermediary between them. Newton himself had said it seemed bizarre: “It is enough that gravity does really exist, and according to laws we have described, and abundantly serves to account for all the motions of the celestial bodies, and of our sea.”

<sup>9</sup>Embittered by the controversy, morbidly fearful of criticism, Newton abandoned science for theology. He made elaborate calculations of the generations from Adam down. He experimented in alchemy and wrote on occult themes—hiding his manuscripts. He twice served in Parliament, was knighted, appointed Warden of the Mint, wasted his time, yet could still astound men by his brilliance. One night, after dinner, he solved a problem that had baffled the greatest mathematicians.

<sup>20</sup>He died in 1727, aged 84. The inscription in Westminster Abbey ends: “Let mortals rejoice that there has existed such and so great an ornament of the human race.” But of himself, he once said: “I seem to have been only like a boy, playing on the seashore and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.

—LEO ROSTEN

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