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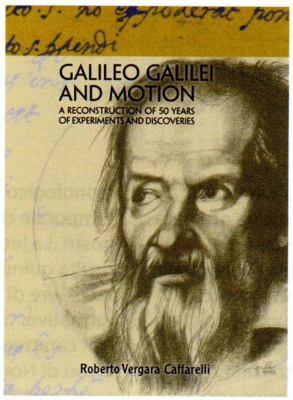

R. Vergara Caffarelli, Galileo Galilei and Motion. A Reconstruction of 50 years of Experiments and Discoveries. SIF, Bologna; Springer Berlin 2009, pp. 304; € 99,95

Galileo's towering achievements in physics are embodied in two laws. The first says that all objects falling from rest accelerate at a constant speed regardless of their weight and that the distance they cover is proportional to the square of the time they fall (this is conveyed in the familiar equation: $s = ½ g t^2$, where s stands for the space, g for the force of gravity and t for time). The second law states that the path of a projectile is always a parabola. Put together, these two of laws later enabled Newton to formulate his famous laws of motion that became the foundation of mechanics and revoluzioned our way of interpreting the physical world.

Historians of science have been fascinated by Galileo's major breakthroughs but it is only in recent years that they have come to grips with their genesis, and with Roberto Vergara Caffarelli's *Galileo Galilei and Motion* we finally have a scholarly reconstruction of Galileo's actual procedure. Vergara Caffarelli's major contribution is his penetrating analysis of the original work that Galileo carried out after his condemnation by the Church in 1633. Although seventy years old and gradually becoming blind, he did not allow himself to become dejected but embarked on the difficult problem of percussion and developed a new field of research. His method, which is as simple as it is ingenious, consisted in suspending two equal masses from a cord astride a pulley. I shall give once instance to provide the reader with an idea of the neatness and simplicity of Galileo's experiments. In the first one, after observing that the two masses were stationary when suspended from the ends of the cord, he gave one of them a downward push, and discovered that the two bodies moved together in *uniform* motion, one rising and the other descending, with the velocity imparted by the push. This confirmed that the principle of inertia operated even in the case when the motion was vertical because the heaviness of one weight cancelled the heaviness of the other. In a second experiment, Galileo supported one of the two masses on a bench, and lifted the other to a preset height. When he let it fall, it rushed downward until the cord became taut and its acceleration was suddenly halted by the other mass that was being pulled up by the cord. The interesting fact was that both masses now moved with *uniform* motion as in the previous experiment.

Galileo's equipment was reconstructed by Vergara Caffarelli and the experiments repeated with great care and precision. It is difficult to travel back four centuries in time in an attempt to understand the science of that age and in the hope of learning how novel Galileo's approach was. Vergara Caffarelli manages to do this and he gives us an insight into the kind of problems that Galileo confronted and the brilliance with which he tackled them. Galileo's research when he was a young university professor in Padua was carried out with the aid of the pendulum and the inclined plane, and Vergara Caffarelli explains in great detail how he proceeded. In the light of his careful study of Galileo's manuscript notes, Vergara Caffarelli reproduced the great scientist's crucial experiments with balls rolling down an inclined plane. The result is interesting inasmuch as it shows that Galileo's was able to measure distances with a precision of one *punto*, a unit that Vergara Caffarelli determined as about 2.3 mm. It should be noted that a value of 0.94 mm had formerly been accepted for the *punto*. This rendered Galileo's precision too good to be true; the new value makes it genuinely admirable.

The correct interpretation of the nature of motion was necessary to reply to objections that were commonly made against Copernicanism. Of course, we cannot experiment with a planet (however small) that revolves around a central body, but Galileo was able to work out the properties of bodies in motion in an enclosed space such as the windowless cabin of a ship. Whether the ship is at rest in a harbour or moving at constant speed on a calm sea, objects that are thrown or dropped inside the cabin will follow the same horizontal or vertical path. In other words, for people inside the cabin there is no way of knowing whether the ship is moving or at rest. This is what we now call Galilean relativity about which Vergara Caffarelli has much to say.

Galileo Galilei and Motion is not an easy book to read for someone who is not acquainted with the physics of motion, but it should have its place on the bookshelves of anyone interested in Galileo and his outstanding contribution to the Scientific Revolution of the seventeenth century.

W. Shea