

*The Mechanical Investigations of Leonardo da Vinci.* By I. B. Hart. Chicago, Open Court Publishing Company, 1925. 2+240 pp.

This book is a very interesting account of a chapter in the history of mechanics, centering around the picturesque figure of Leonardo da Vinci. Leonardo's fame as the painter of *The Last Supper* and *Mona Lisa* has tended to cause an undervaluation of the excellent pioneer work which he did in the field of statics and dynamics. Dr. Hart has here assembled in good form the most important of these results, and has added a translation of the manuscript of Leonardo on the *Flight of Birds*, the only complete translation into English, so far as I know, of a manuscript of Leonardo.

There are eight chapters: I, pp. 1-12, a general discussion of Leonardo's manuscripts; II, pp. 13-35, mechanical science in the 15th century (largely devoted to the instruments used); III, pp. 36-53, contemporary scientific influences; IV, pp. 54-74, Leonardo's sources; V, pp. 75-98, Leonardo's work in dynamics; VI, pp. 99-142, Leonardo's work in statics; VII, pp. 143-193, Leonardo as a pioneer of aviation; VIII, pp. 194-235, translation of Leonardo's manuscript on the flight of birds. There is a good index.

To give some idea of the scope of Leonardo's work, a few of the results that are brought together in Dr. Hart's book may be mentioned. In dynamics, Leonardo stated the principle of inertia, and that of the equality of action and reaction, at least in special cases. He anticipated Galileo in stating the law for the velocity acquired by a falling body, though he did not succeed in obtaining the correct result for the distance fallen, thinking it, like the velocity, to be proportional to the time. Similar results are stated for bodies rolling down an inclined plane; but here, as also in his attempts at the composition and resolution of forces, he was much handicapped by lack of knowledge of trigonometry, which science was not yet generally known to Europeans, as Regiomontanus's great treatise, though existing in manuscript, was not published till much later (1533).

In statics, Leonardo determines certain centers of gravity, including (perhaps for the first time) that of the pyramid; studies the principles of the lever and pulley, giving nearly all the combinations that modern textbooks discuss; shows how power may be transmitted by various types of gearing; and considers the problem of loaded beams.

The last two chapters are the most important part of the book, since Leonardo's study of the flight of birds forms one of the most significant and valuable of the attempts of men to learn the secret of flight. We find here very careful observations of birds and the various motions of their wings, also the action of the tail as a rudder; and clever reasoning on the center of gravity and center of pressure, and the mechanical principles involved, including the case of soaring flight. The observations and discussions are illustrated by fine drawings.

Thus Leonardo da Vinci is seen to have been a pioneer in the development of aviation; and Dr. Hart's book, which makes these results available to the English reader, is accordingly a valuable addition to the literature of the history of science.

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