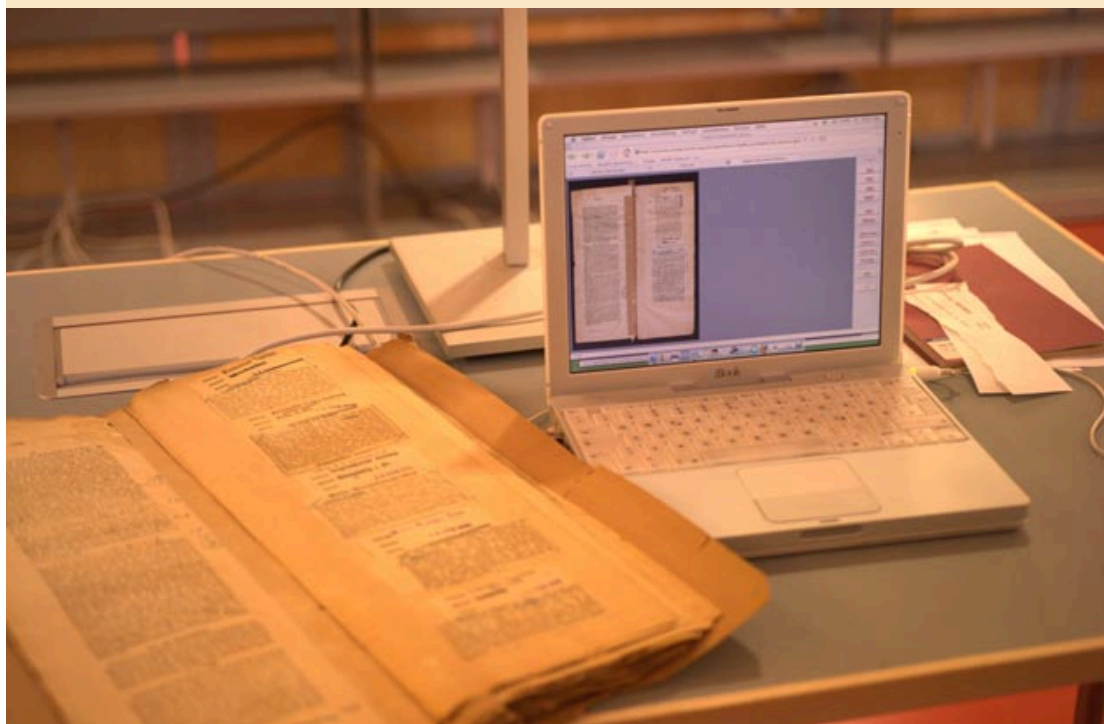
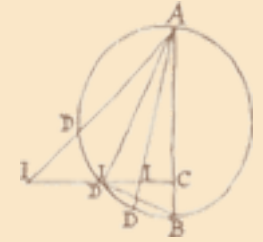


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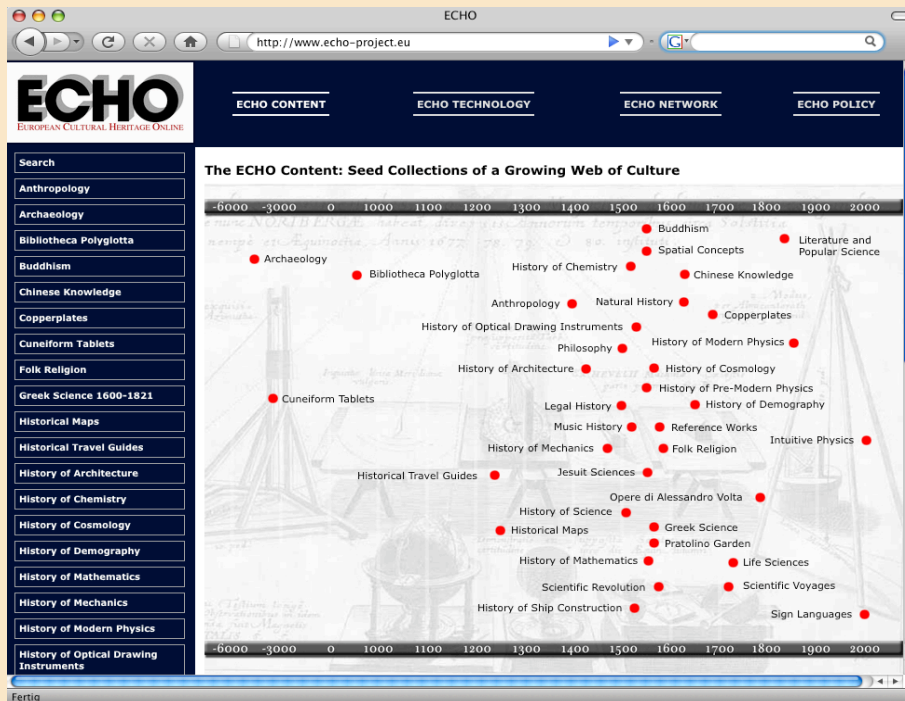
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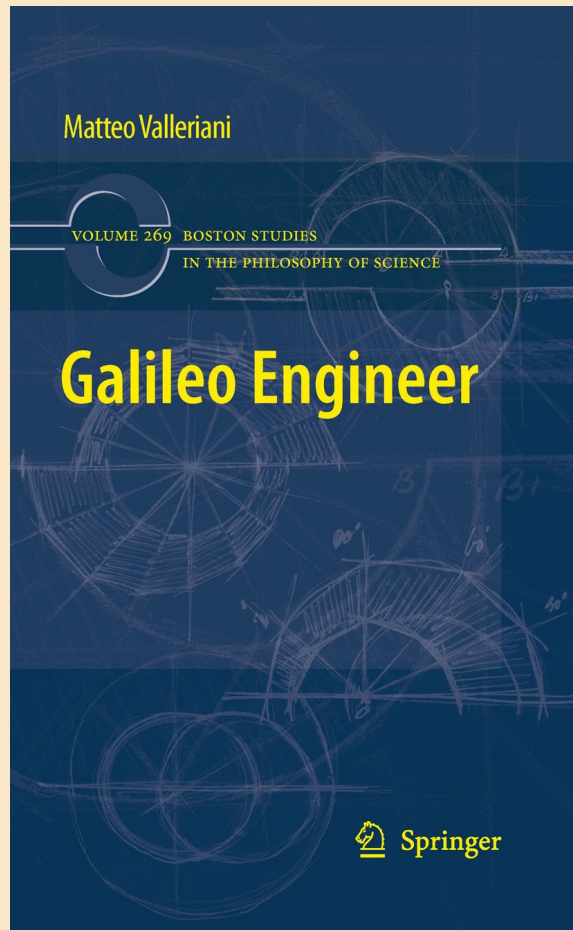
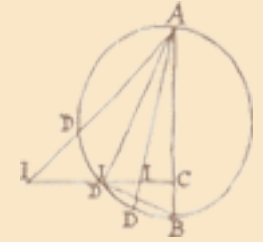
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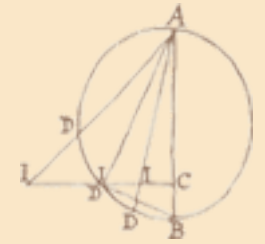
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Overview of Folio Page 193 r

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Galileo Galilei
Ms. Gal. 72

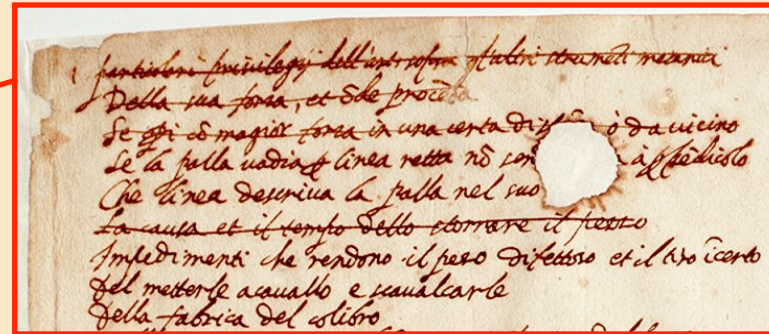
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Folio 193 r (final text)

IA
IB
IC
ID
IE
IF
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IH
II
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IN
IO

Se la palla vada per linea retta, non sen[do] tirata a perpendicolo.
Che linea descriva la palla nel suo [moto].
Impedimenti che rendono il pezzo difettoso et il tiro incerto.
Del metterle a cavallo e scavalcarle.
Della fabrica del colibro.
Dell'esamine circa la bontà et giustezza del pezzo.
Se quanto più e [è] lungo il pezzo più tira lontano, e perché.
Che si tornare la palla ingiù nel perpendicolo, torna con le medesime forze et velocità con che andò in su.
Diverse palle di artillate et lanterne, et lor uso.

Size Height 300 mm, width 214 mm.
Comments Written by Galilei; contains table.
References Caserini 1972 519-520; Donagrow et al. 1992 203 footnote; Wohlwill 1899 620



Galileo and the Challenge of the Arsenal

http://echo.mpiwg-berlin.mpg.de/... collected papers

Galileo as a teacher of artillery

Among his papers Galileo left the outline of an unwritten treatise entitled "Particular privileges of the artillery with respect to other mechanical instruments"^[13] probably dating back to his early years in Padua. The planned treatise was possibly related, just as other writings extant from this period such as the treatise *Le Mecaniche*^[14] or the writings on the military compass, to Galileo's private teaching. This essentially followed a curriculum which covered the whole spectrum of issues needed for the education of military officers. The following selection from topics listed in Galileo's outline make it indeed clear that his planned treatise was not intended to expound a new theory of motion but to deal with issues of practical interest to military commanders and artillerymen.

If one operates with a greater force in a certain distance or from nearby if the ball goes along a straight line if it is not projected along the vertical which line the ball describes in its course on the course and the time of charging the canon [...] In which elevation you shoot farthest and why That the ball in turning downwards in the vertical returns with the same forces and velocities as those with which it went up [...]

Although the purpose of the planned treatise was not comparable to that of Galileo's later deductive treatment of projectile motion in the fictive treatise *De Motu locali* presented by Salviati in the *Discorsi*, basic insights on which the latter treatise was founded were evidently already part of Galileo's exposition of ballistics for practitioners. In particular, he refers to the elevation of maximum range shots, the symmetry of the trajectory, its continuous curvature, and clearly indicates that he knows its shape.

Galileo's compilation of issues is typical for military treatises of the time. All these treatises, in fact, reflect the *shared knowledge* of the practitioners of ballistics, primarily transmitted by participation and oral transmission. It was, for instance, part of the basic professional experience of artillerymen that the speed of a projectile increases with the force the exploding powder exerts on it, that an increased weight of the projectile requires more force to reach the same distance, that the distance of the shot depends on the angle, that there is an angle at which this distance reaches a maximum and that there are angles at which flat and steep shots reach the same distance though with different effects. Any theory of projectile motion advanced at that time had to take into account this common knowledge of the practitioners of ballistics

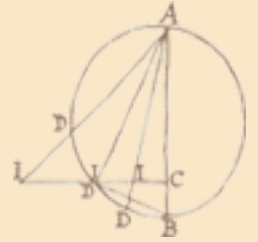
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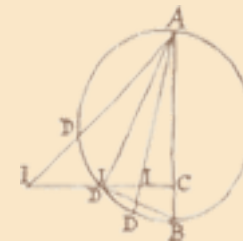
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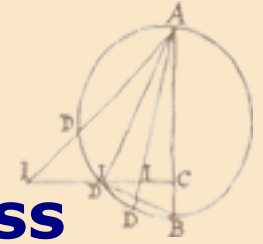
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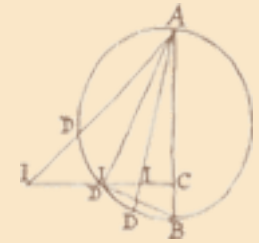
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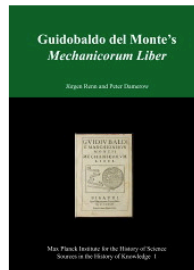
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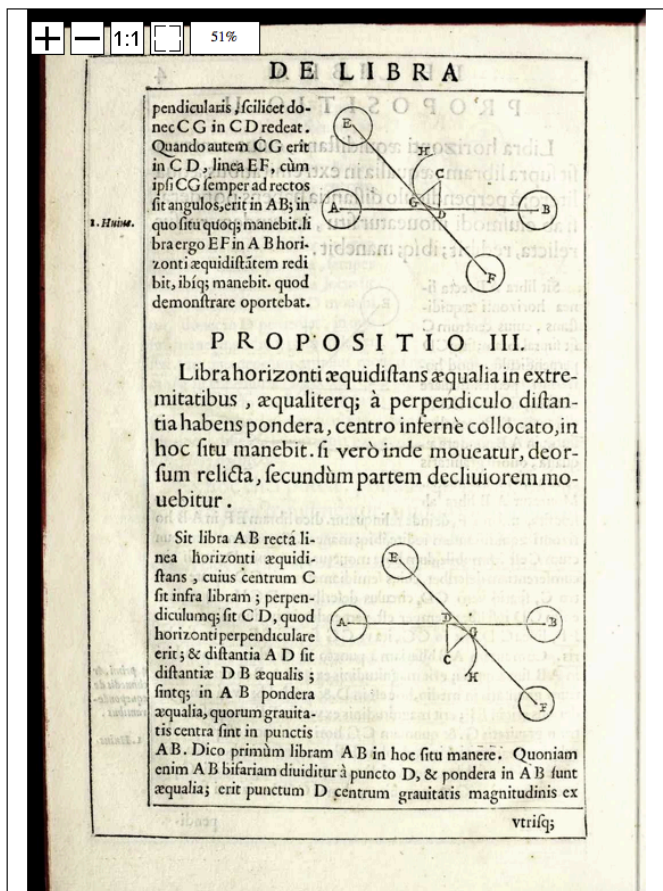
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3.5 The chapter *De Vecte*

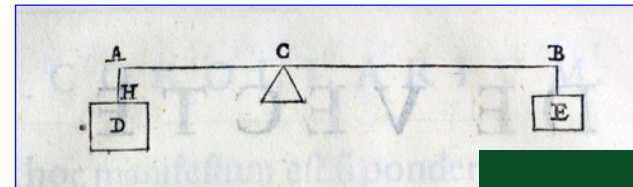


Figure 3.3: The lever (*vecte*) with a weight *D* (*pondus*) hanging down from *AH*. The weight is compensated by a force *E* (*potentia*) acting at point *B*.

From a modern point of view there is no substantial difference between that is, a steelyard (*statera*), and a lever. Guidobaldo, however, treats the added the balance to the five simple machines of Heron as a sixth one, in the initial chapter before dealing with the lever in the following chapter.²³

The reason may be that he followed the theoretical program promoted by *Mechanica* which, as has been mentioned before, was well known and followed in the 16th and 17th centuries.²⁴ According to this treatise, the function of mechanical devices, to be explained, is to reduce the required forces: (#)

¶ When, then, we have to produce an effect contrary to nature, with great difficulty, and require skill (*technè, τέχνη*). Therefore we call them mechanical difficulties, a device (*mèchanè, μηχανή*). For as the poet Antiphon says: "To gain mastery over things in which we are conquered by nature." The less master the greater, and things possessing little weight may be moved by great forces, and things possessing little weight may be moved by great forces, and things possessing little weight may be moved by great forces. These are similar devices which we term mechanical problems.²⁵ (#)

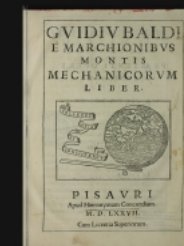
According to the Aristotelian program, this functioning of mechanical devices and the functioning of the lever which itself has to be traced back to the function of the circle, is explained by the miraculous properties of the circle: (#)

¶ ... there is nothing strange in the circle being the first of all machines to depend upon the circle, and those about the lever upon the balance. The problems of mechanical movement can depend upon the lever.²⁶

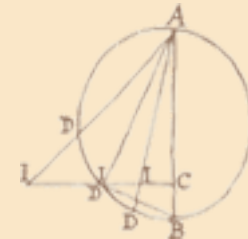
Thus, by putting his own chapter on the balance in front of his chapters on the lever, Guidobaldo simply merges the theoretical programs of Heron and of Aristotle's treatise, who may or may not have been Aristotle himself. (#)

Guidobaldo del Monte's *Mechanicorum Liber*

Jürgen Renn and Peter Damerow



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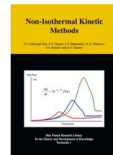
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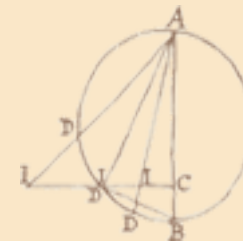
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