Simon Stevin

Auszug aus
„Beghinselen der Weegconst“
(1585)

Quelle: Simon Stevin: Beghinselen der Weegconst. - Leiden, 1585. Übersetzung ins Englische in: The principal works of Simon Stevin. - Amsterdam: Swets and Zeitlinger, 1955. In: A source book in mathematics : 1200 - 1800 / ed. by Dirk J. Struik . - Cambridge, Mass. : Harvard Univ. Press , 1969

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THEOREM II. PROPOSITION II

The center of gravity of any triangle is in the line drawn from the vertex to the middle point of the opposite side.

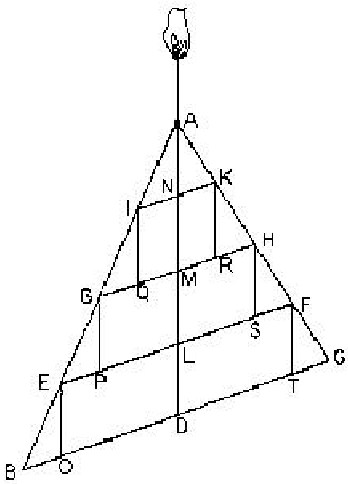

Fig. 1

Supposition. Let *ABC* [Fig. 1] be a triangle of any form, in which from the angle *A* to *D*, the middle point of the side *BC*, there is drawn the line *AD*.

What is required to prove. We have to prove that the center of gravity of the triangle is in the line *AD*.

Preliminary. Let us draw *EF*, *GH*, *IK* parallel to *BC*, intersecting *AD* in *L*, *M*, *N*; after that *EO*, *GP*, *IQ*, *KR*, *HS*, *FT*, parallel to *AD*.

Proof. Since *EF* is parallel to *BC*, and *EO*, *FT* to *LD*, *EFTO* will be a parallelogram, in which *EL* is equal to *LF*, also to *OD* and *DT*, in consequence of which the center of gravity of the quadrilateral *EFTO* is in *DL*, by the first proposition of this book[1]. And for the same reason the center of gravity of the parallelogram *GHSP* will be in *LM*, and of *IKRQ* in *MN*; and consequently the center of gravity of the figure

[1] Theorem I, Proposition I is: “The geometrical center of any plane figure is also its center of gravity." The proof is given for an equilateral triangle, a parallelogram, and a regular pentagon. The meaning of the proposition is that when a figure has a center of symmetry, it is its center of gravity. Then in Theorem II, Proposition II, Stevin discusses the case of an arbitrary triangle, and for this he needs infinitesimals.
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IKRHSFTOEPGQ, composed of the aforesaid three quadrilaterals, will be in the line *ND* or *AD*. Now as here three quadrilaterals have been inscribed in the triangle, so an infinite number of such quadrilaterals can be inscribed therein, and the center of gravity of the inscribed figure will always be (for the reasons mentioned above) in the line *AD*. But the more such quadrilaterals there are, the less the triangle *ABC* will differ from the inscribed figure of the quadrilaterals. For if we draw lines parallel to *BC* through the middle points of *AN*, *NM*, *ML*, *LD*, the difference of the last figure will be exactly half of the difference of the preceding figure[2]. We can therefore, by infinite approximation, place within the triangle a figure such that the difference between the latter and the triangle shall be less than any given plane figure, however small. From which it follows that, taking *AD* to be the center line of gravity,[3] the apparent weight of the part *ADC* will differ less from the apparent weight of the part *ADB* than any plane figure that might be given, however small, from which I argue as follows:[4]

A. Beside any different apparent gravities there may be placed a gravity less than their difference;

0. Beside the present apparent gravities *ADC* and *ADB* there cannot be placed any gravity less than their difference;

0. Therefore the present apparent gravities *ADC* and *ADB* do not differ.

Therefore *AD* is the center line of gravity, and consequently the center of gravity of the triangle *ABC* is in it.

Conclusion. The center of gravity of any triangle therefore is in the line drawn from the vertex to the middle point of the opposite side, which we had to prove.

Problem I, Proposition III. Given a triangle: to find its center of gravity.

Supposition. Let *ABC* be a triangle [Fig. 2].

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[2] It is obviously assumed that the side *AB* is divided into n equal segments (in the figure $n = 4$). The difference between the area Δ of the triangle *ABC* and that of the figure consisting of $(n — 1)$ parallelograms is Δ /n.

[3] The statement that *AD* is the center line of gravity seems to mean that *AD* is the vertical through the point of suspension of the triangle at rest and hence, by the rule of statics quoted by Stevin earlier in the book (Book I, Prop. 6: The center of gravity of a hanging solid is always in its center line of gravity), the center of gravity is in *AD*. (Notes 2 and 3 are based on footnotes in the *Principal works*, I).

[4] Stevin here uses the form of the syllogism known in ancient logic as *CAMESTRES* (vowels *AEE*, *A* universal affirmation, as all *P* are *Q*, *E* universal negation, as no *P* are *Q*). He uses this formulation repeatedly (see *Principal works*, I, 143, note 2).

The reasoning amounts to this: When we know that the difference of two quantities *A* and *B* is smaller than a quantity that can be taken as small as we like, then $A = B$. The *reductio ad absurdum*, typical of the Greeks, is replaced by a syllogism.

It has been justly observed that Stevin's way of reasoning constitutes an important step in the evolution of the limit concept; see H. Bosmans, "Sur quelques exemples de la théorie des limites chez Simon Stevin," *Annales de la Société Scientifique de Bruxelles 37* (1913), 171-199; "L'Analyse infinitésimale chez Simon Stevin," *Mathesis* 37 (1923), 12-18, 55-62, 105-109, summarized in sec. V of Bosmans, "Le mathématicien belge Simon Stevin de Bruges," *Periodico de mathematiche* (ser. 4) *6* (1926), 231-261.

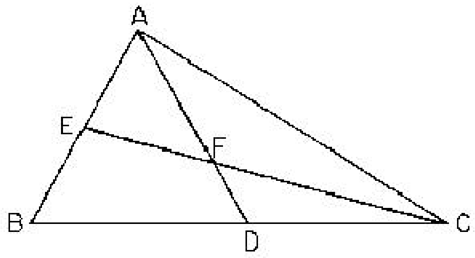

Fig. 2

What is required to find. We have to find its center of gravity.

Construction. There shall be drawn from *A* to the middle point of *BC* the line *AD*, likewise from *C* to the middle point of *AB* the line *CE*, intersecting *AD* in *F*. I say that *F* is the required center of gravity.

Proof. The center of gravity of the triangle *ABC* is in the line *AD*, and also in *CE*, by the second proposition. It is therefore *F*, which we had to prove.

Conclusion. Given therefore a triangle, we have found its center of gravity, as required.

The next propositions deal with centers of gravity of specific figures; for instance, Theorem V, Proposition VII, states that "the center of gravity of the quadrilateral with two parallel sides is in the line joining the middle points of those sides," and in Problem IV, Proposition XII, we find that the center of gravity of any parabolic segment is at three-fifths of its diameter. Stevin then finds the center of gravity of the parabolic segment at the point E on AD such that AE: ED = 3 : 2.

Before we pass to Kepler and his approach to the limit concept, we shall quote the formulation given by the Italian Luca Valerio (1552-1618) in his De centra gravitatis solidorum (Rome, 1604; 2nd ed., Bologna, 1659):

"If a quantity, either greater or smaller than a first quantity, has had a proportion to a quantity greater or smaller than a second quantity, with an excess or defect smaller than any arbitrary quantity [excessu, vel defectu quantacumque proposita], then the first quantity will have to the second the same proportion."

For instance, if we wish to prove that the areas of two circles C^ and Cz are as the squares of the diameters with the aid of inscribed (circumscribed) polygons, as Euclid does (Elements, XII, Proposition 2), then these areas are the first and second quantity, and the smaller (greater) quantities, differing from them by an arbitrary quantity, are the areas of the inscribed (circumscribed) polygons with the same number of sides.