



The Limits Of Simon Stevin



CASA seminar 25 January 2006, Yves van Gennip





Outline

His Life, His Universe And Everything

The Times

His Life

What Subjects Did He Write About?

Inventions And Discoveries

De Beghinselen Des Waterwichts

Conclusions





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What Did The World Do While Stevin Lived?

1548 – 1620

- On the brink of the Scientific Revolution: experiments find their way into science
- Relatively new professions that need mathematics become more important, like gauger, wine measurer, grain measurer, land surveyor and accountant
- Eighty Year's War (1568 – 1648): war of secession between the Netherlands and the Spanish king





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Some Main Points of Stevin's Life

Birth in 1548 in Brugge





What Else Did The Man Do?

- 1577 Clerk in Brugge
- 1583–1590 Student at the University of Leiden
- 1593 Advisor to prince Maurits, the son of Willem van Oranje
- 1604 Quartermaster in the army of the prince
- 1620 Stevin dies, (probably) in Den Haag





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Among The Subjects Stevin Wrote About Are:

- Algebra
- Arithmetic
- Geometry
- Logic
- Mechanics
- Hydrostatics
- Forts
- Navigation
- Armies
- Music theory
- Perspective theory
- Astronomy
- Politics
- Economics





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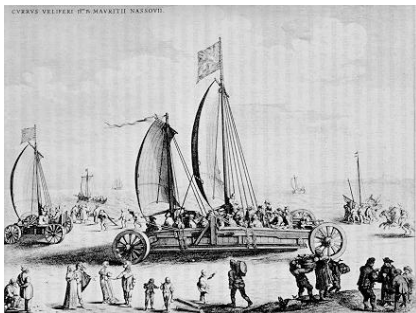
Conclusions





Some Of The Things Stevin's Credited For

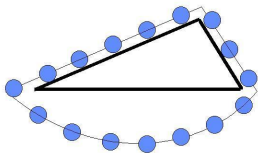
- The use of windmills to pump water away
- The land yacht, though the Chinese had it earlier





Some more accomplishments

- First use of the impossibility of a perpetuum mobile ("een eeuwich roersel . . . t'welk valsch is")
- Two bodies on two different, inclined planes are in balance if their weights are proportional to the lengths of the two planes



- The composition law of forces (parallelogram of forces)





And Then Some

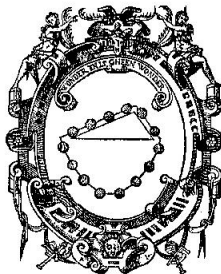
- Galilei's famous experiment with weights falling from a tower, at least three years before Galilei supposedly did this
- First European to give a mathematically accurate specification for *equal temperament* in music theory (simultaneously with Chu Tsai-Yu in China)
- Writing about science in Dutch and introducing words like "wiskunde", "aftrekken", "loodrecht" and "stelling"
- Writing the first book about logic in Dutch
- Creating a notation for and advertising the use of base ten decimal fractions ("De Thiende")





Foundations Of Hydrostatics (1586)

DE
 BEGHINSELEN¹⁵⁸⁶
 DES WATERWICHTS
 BESCHREVEN DVER
 SIMON STEVIN
 van Brugghe.



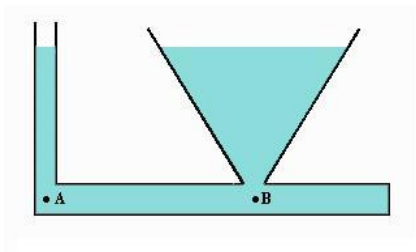
TOT LEYDEN,
 Inde Druckerij van Christoffel Plantijn,
 By François van Raphelinghen.
 c10. 10. LXXXVI.





Three Important Accomplishments In This Work

- Proof of Archimedes' law
- Discovery of the hydrostatic paradox (water pressure depends only on the height of the water)

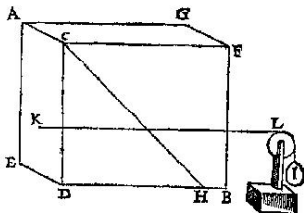


- Giving water pressure on any side of a vessel



Water Pressure Against A Wall

With The Use Of A Limit Argument

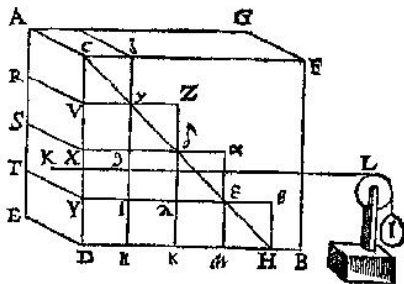


Proposition: Let AB be a volume of water. Let $DH = DC$ and let I be a weight which exerts a force on the point K , which is the center of mass for the wall $ACDE$. Furthermore $KL \parallel DH$. If the force exerted by I on K is equal to the weight of the water volume $ACHDE$, then the wall is in equilibrium.





Construction



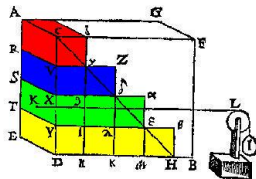
Construct:

- $V\gamma = \gamma Z = \delta\alpha = \epsilon\beta$
- $VZ \parallel X\alpha \parallel \gamma\beta \parallel DH$
- $\zeta\eta \parallel Z\kappa \parallel \alpha\mu \parallel BH \parallel CD$



Proof

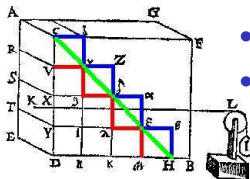
Using the hydrostatic paradox which he proved earlier in the book, Stevin proves for the weights:



- $0 \leq ACVR \leq AC\zeta\gamma VR$
- $AC\zeta\gamma VR \leq RVXS \leq RVZ\delta XS$
- $SX\delta\lambda YT \leq SX\epsilon\alpha YT \leq SX\alpha\epsilon YT$
- $TY\epsilon\mu DE \leq TYDE \leq Y\beta HDE$



The Point Of It All



- Combining the previous results:
 $RV\gamma\theta\delta\lambda\epsilon\mu DE \leq ACDE \leq AC\zeta\gamma Z\delta\alpha\epsilon\beta HDE$.
- Repeat construction ad infinitum.
- All weight that differs less from the weight against $ACDE$ than any amount that can be given is equal to the weight against $ACDE$.
- Thus $ACDE = ACHDE$.



Recap With The End In Sight

- Simon Stevin contributed in a lot of areas with his mathematical skills.
- In hydrostatics he was the first one since Archimedes to contribute significantly
- He used limit arguments in his proofs.



Some Interesting Reading (In Dutch)

Available At The TU/e Library



Various authors

Simon Stevin (1548–1620) - De geboorte van de nieuwe wetenschap.

Brepols Publishers, Turnhout, 2004.



Jozef T. Devreese & Guido vanden Berghe

'Wonder en is gheen wonder' - De geniale wereld van Simon Stevin 1548–1620.

Jozef T. Devreese en Guido vanden Berghe en Uitgeverij Davidsfonds n.v., Leuven, 2003.