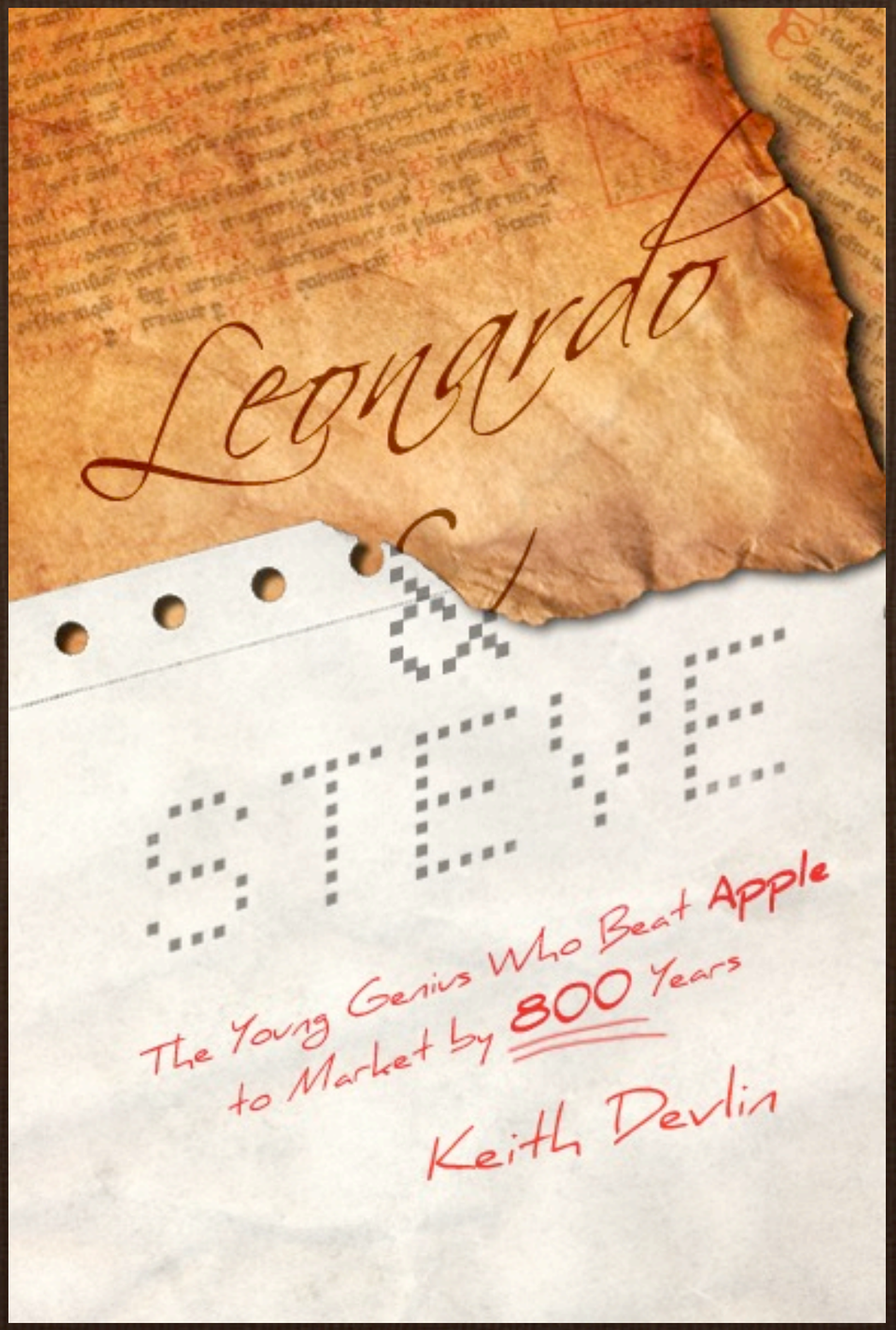
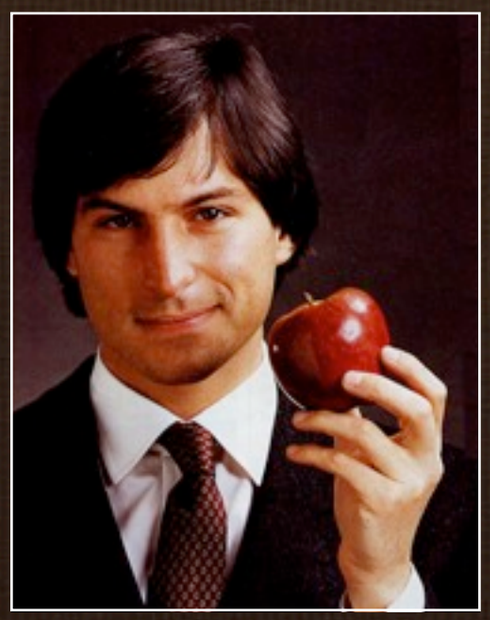
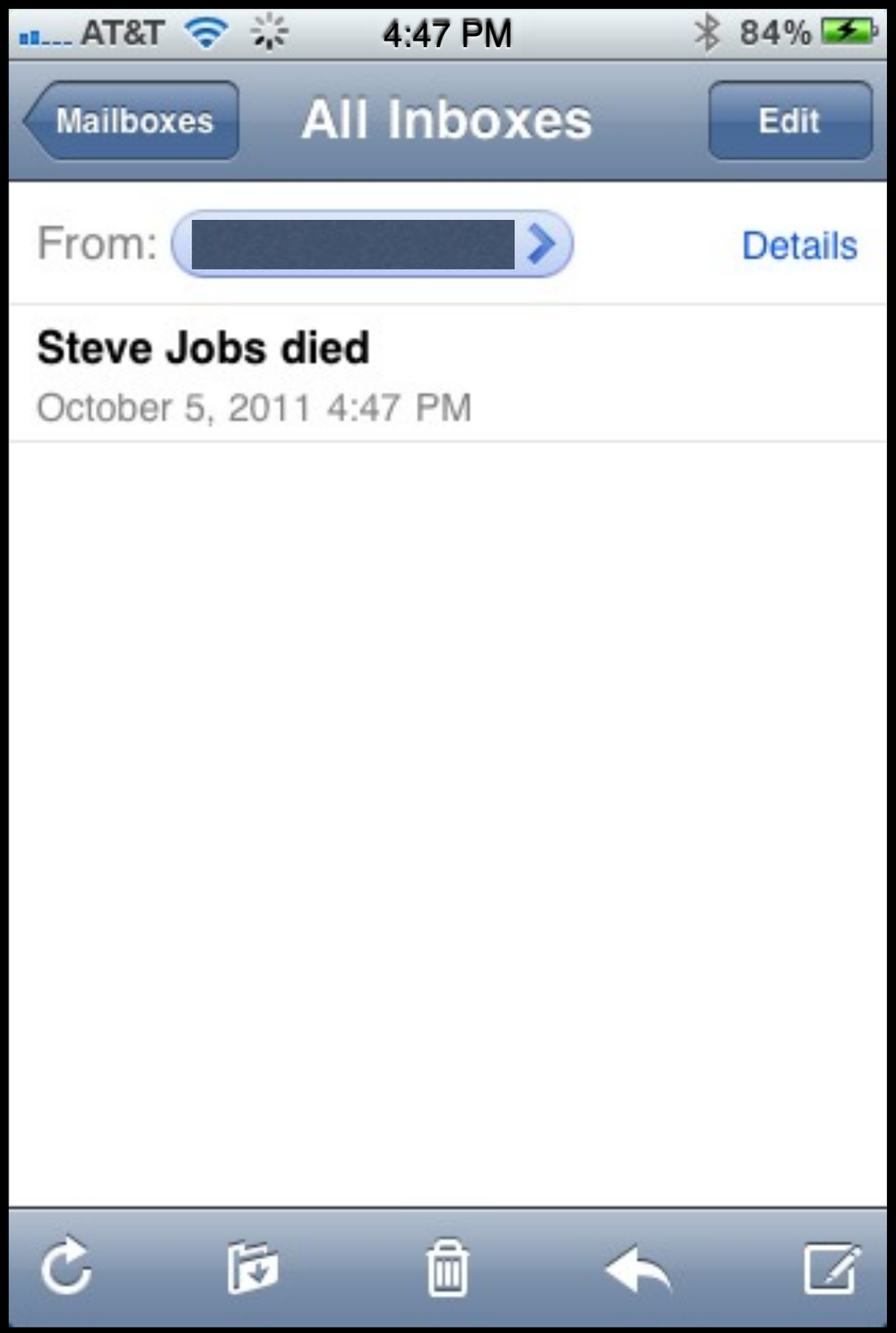




PRELUDE

A memorial

October 5, 2011, 4:47 pm



Email received on my iPhone, Oct 5, 2011, 4:47 pm

Apple Store, Palo Alto, Oct 6, 2011, 7:30 am

Apple Store, Palo Alto, Oct 6, 2011, 7:30 am

Apple Store, Palo Alto, Oct 7, 2011

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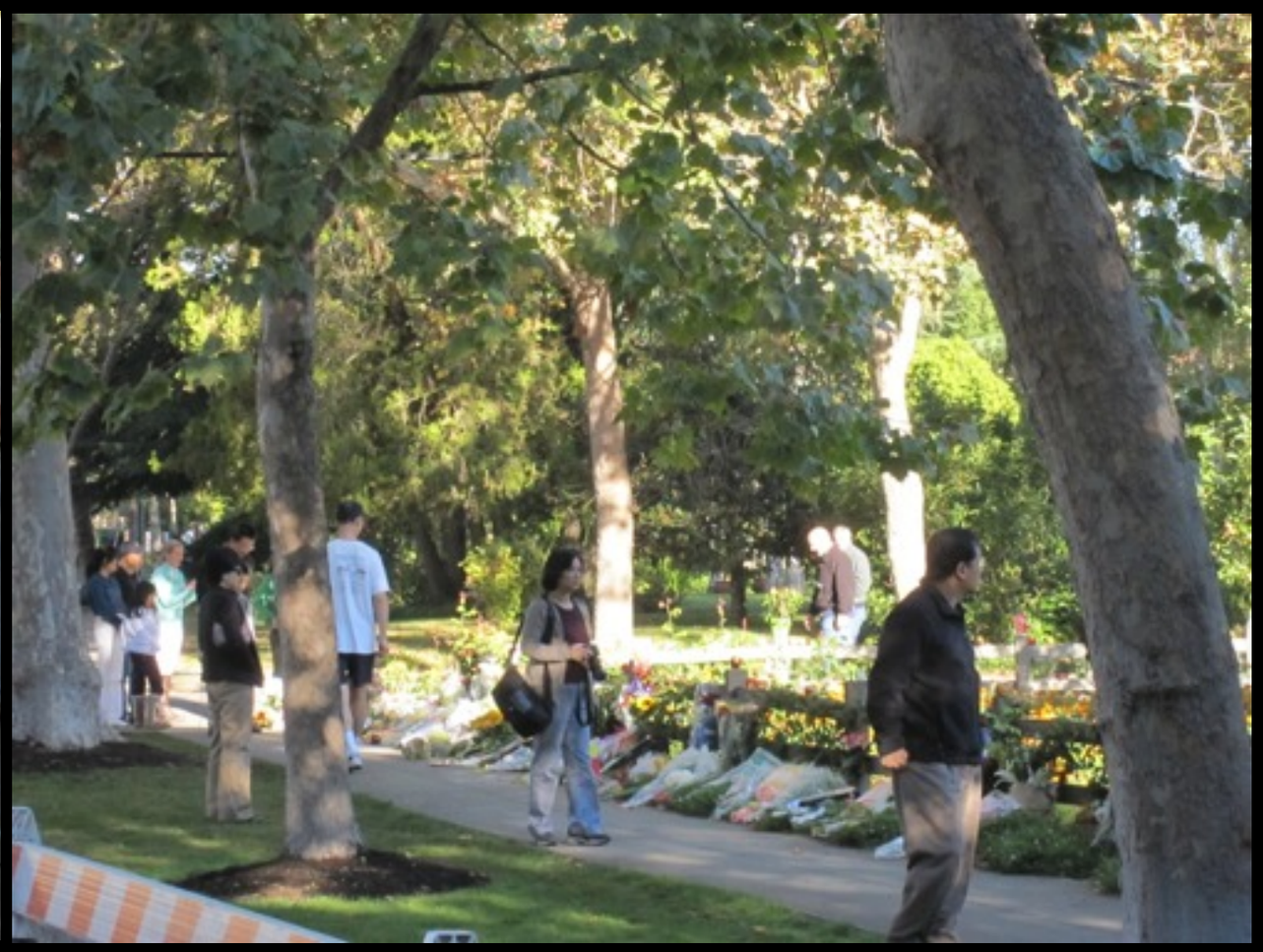

Steve Jobs' house, Waverley Street, Palo Alto, Oct 8, 2011

The First Personal Computing Revolution

Who was this? Where? When?

The young man could hardly contain his excitement. He was sure the invention he had just seen could change the world. It would usher in a new era of personal computing. No longer would a businessman or trader have to rely on a member of the select brotherhood of computing professionals to crunch the numbers. He could do it himself.

The people who showed him the invention were fascinated by how it worked, but they clearly did not see what the young man could: its huge commercial potential. As so often happens in history, the right person was in the right place at the right time. Not only had the young man shown mathematical talent at an early age, he had grown up in what was then the acknowledged world capital for innovation, particularly in the business world. He also had the savvy to know how to make the invention available to ordinary citizens. The trick was to package and market it to them directly, in a way that they could at once appreciate and understand.

Within a few years, the young man had succeeded beyond all expectations – save perhaps for his own far-sighted vision. The personal computing revolution was underway, new businesses were being created, new ways of carrying out international trade and commerce were developing, new financial institutions were being established, and new fortunes were being made. The world would never be the same again.

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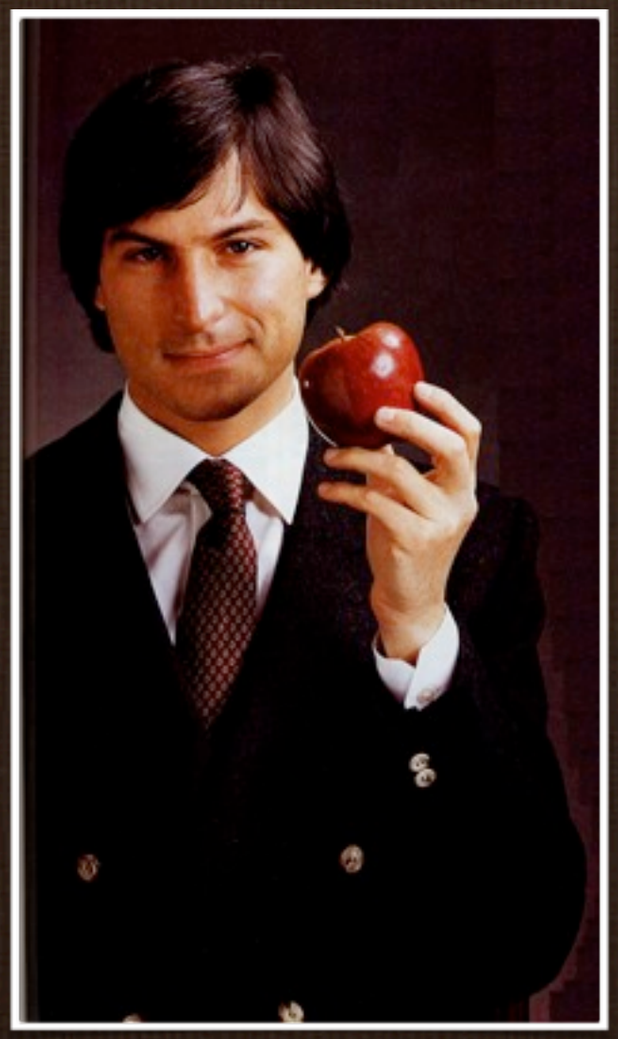

Silicon Valley, 1979-1984

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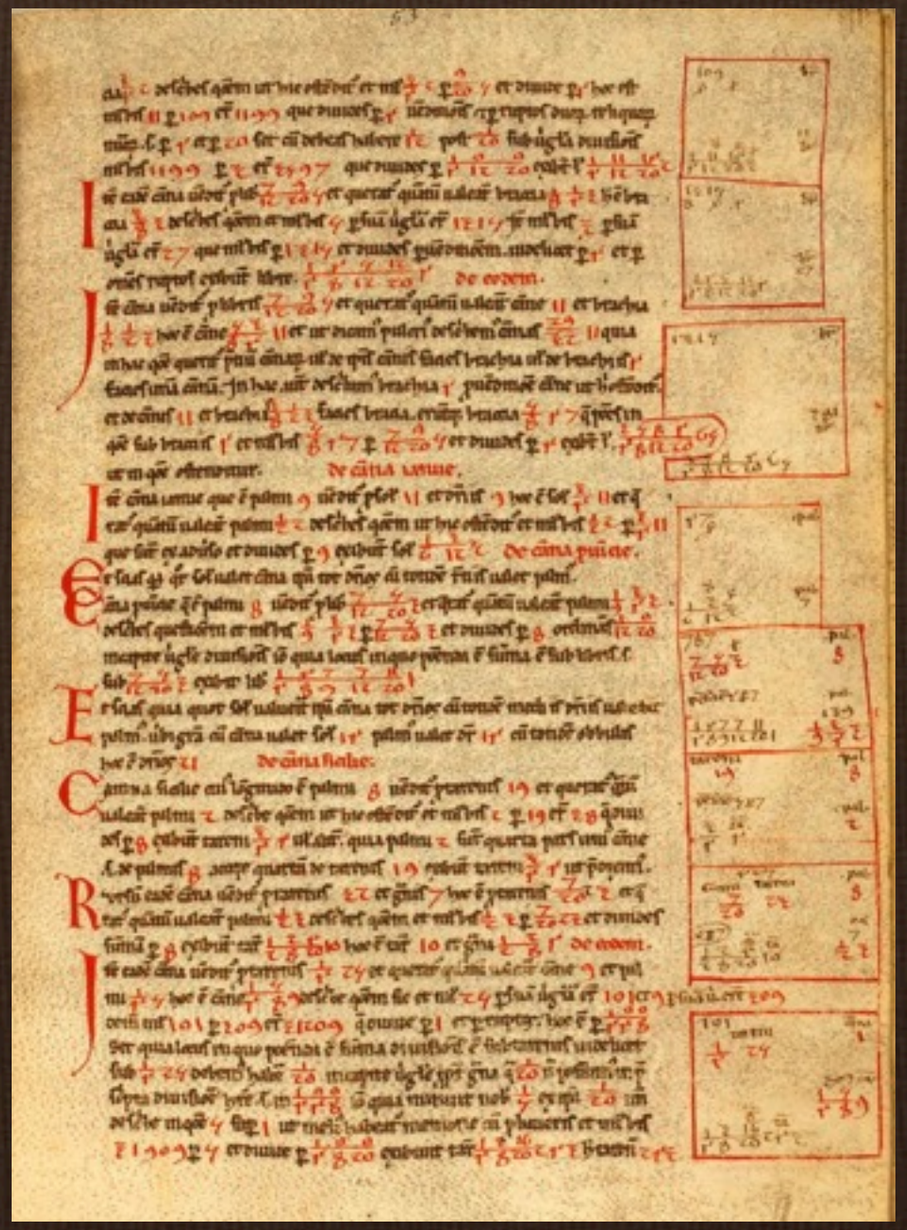

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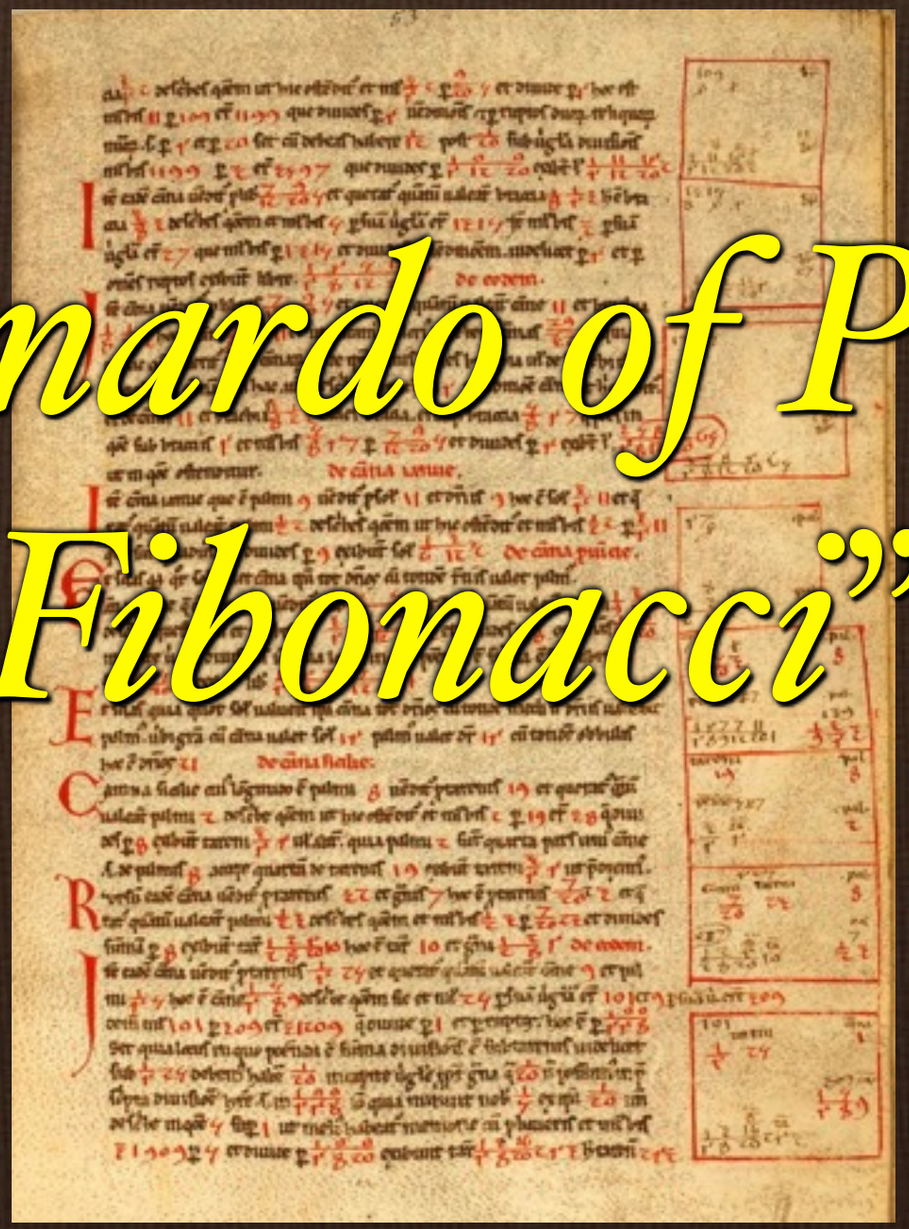

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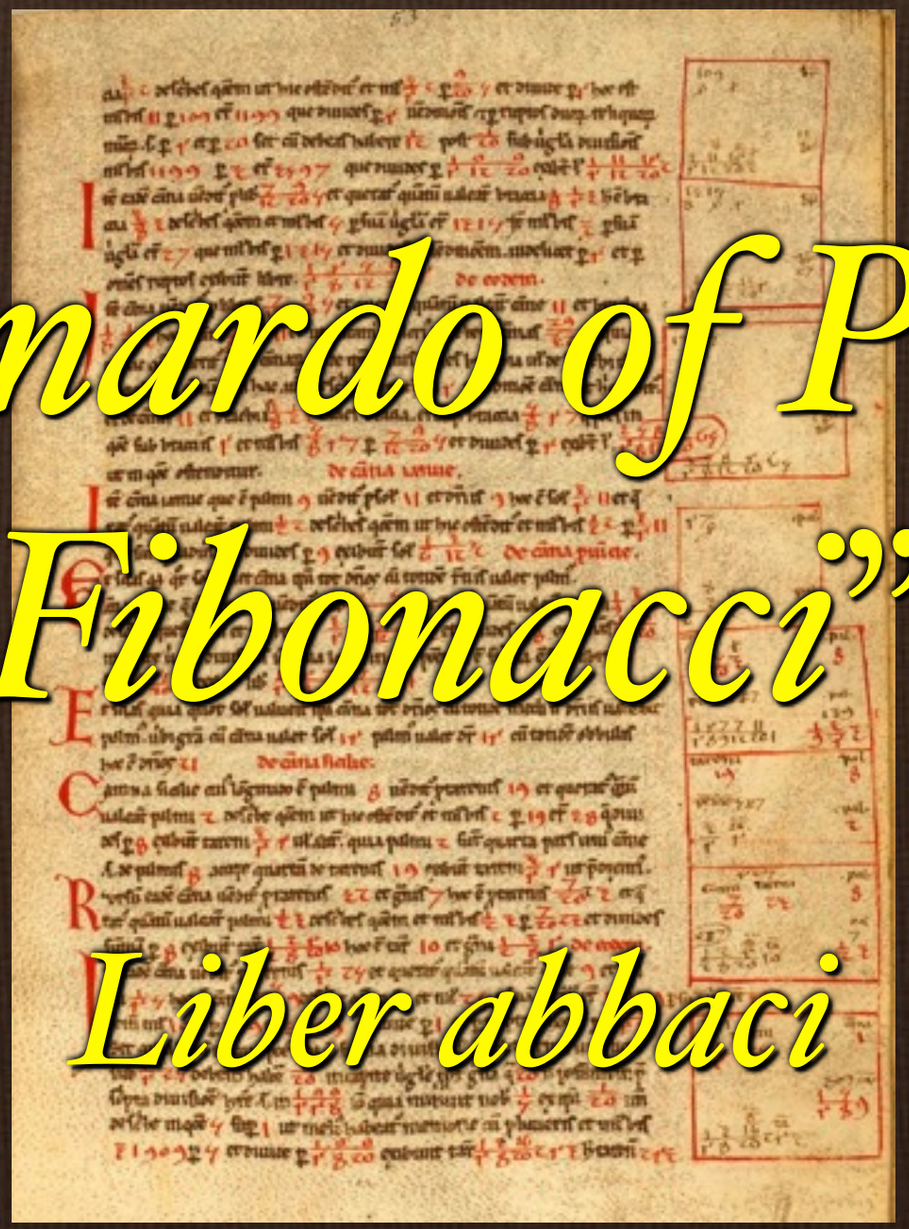

Liber abbaci

Pisa, Italy, 1190-1230

Another memorial

***Piazza XX Settembre* across destroyed Central Bridge, September 1944**

Another memorial

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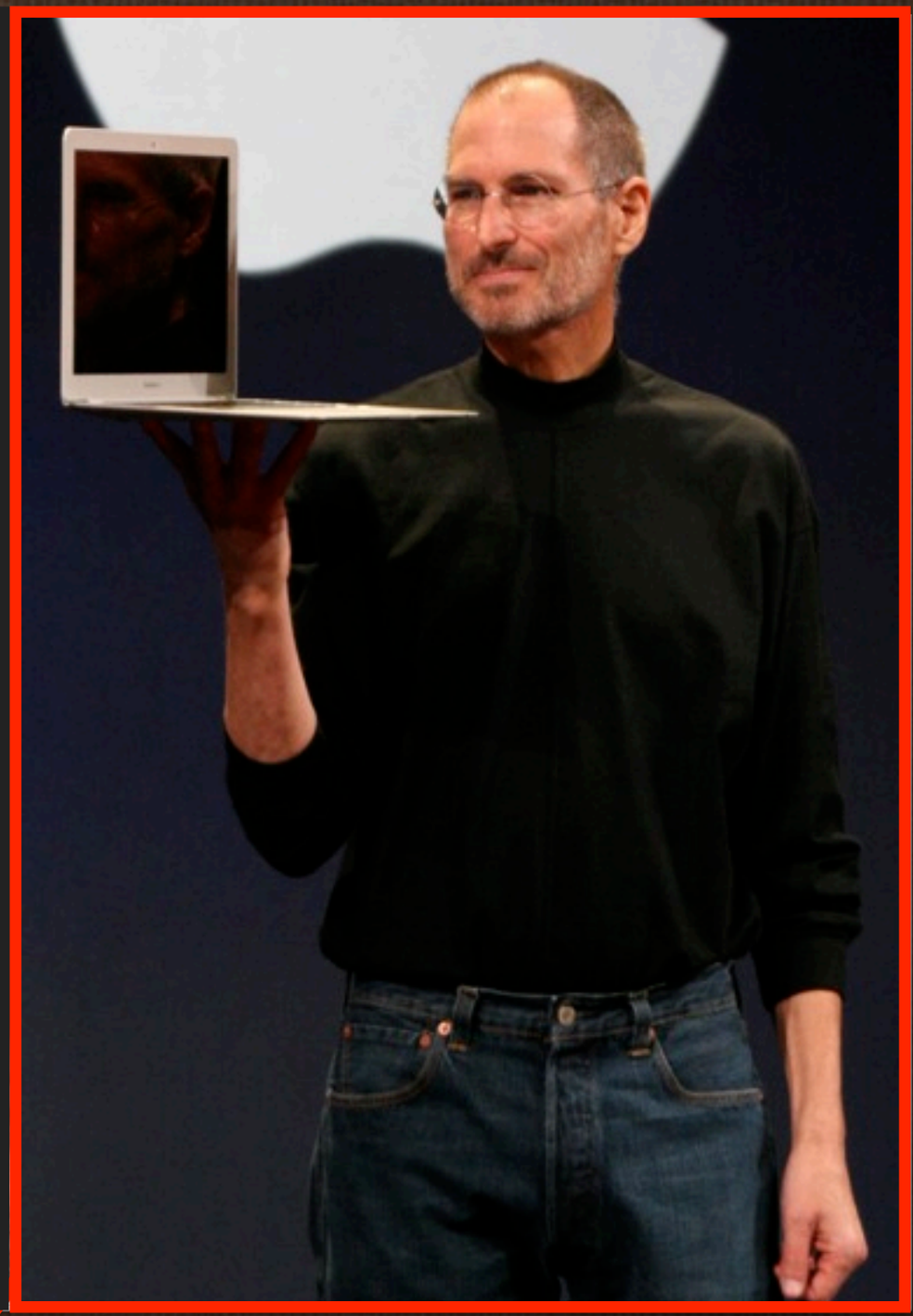
Piazza XX Settembre **across destroyed Central Bridge, September 1944**

The comparison



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- Completed in 1202, this book is generally credited with bringing the Hindu-Arabic number system and its arithmetic to Europe, and launching the modern, Western-led, commercial world.

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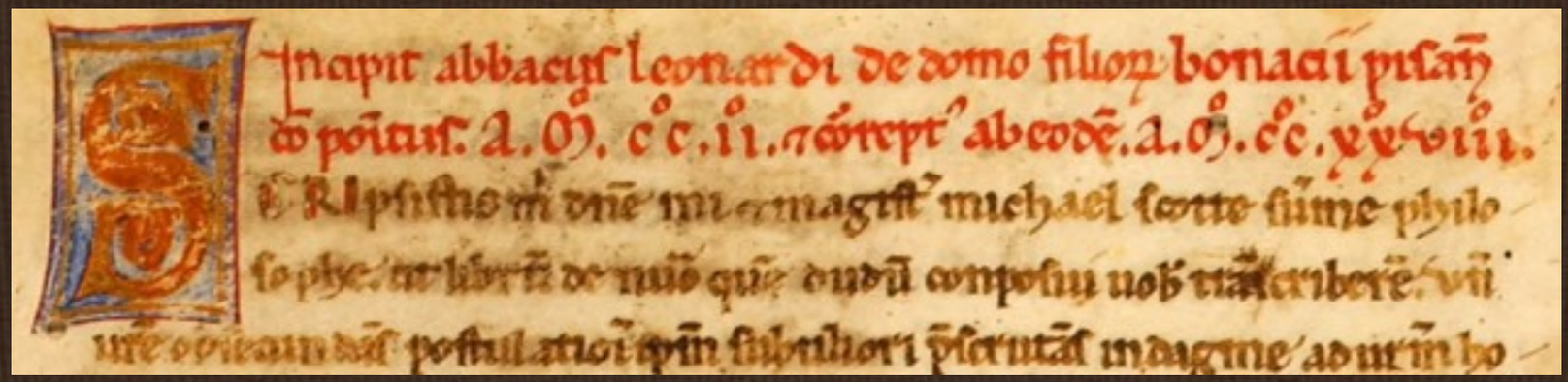

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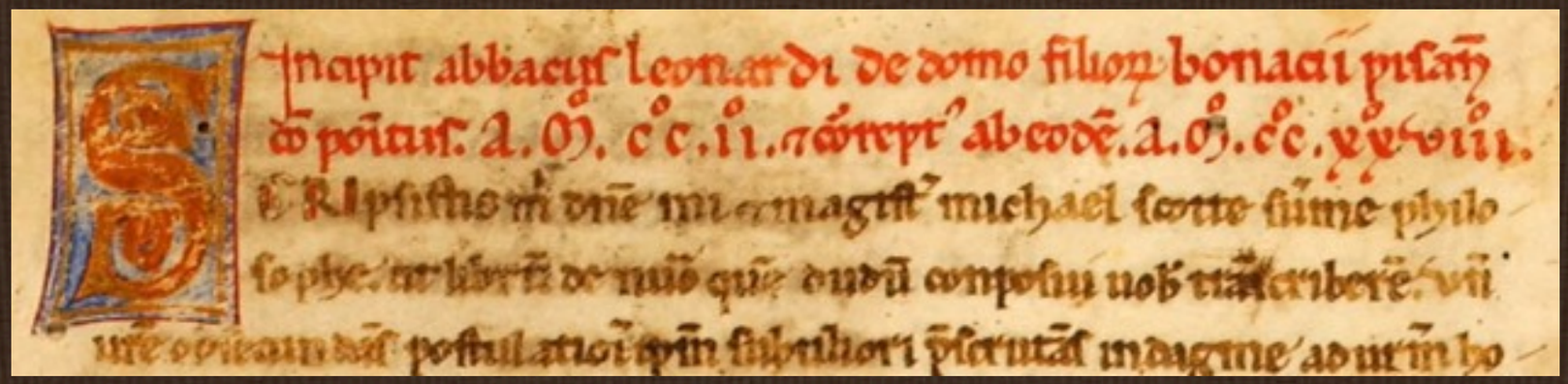

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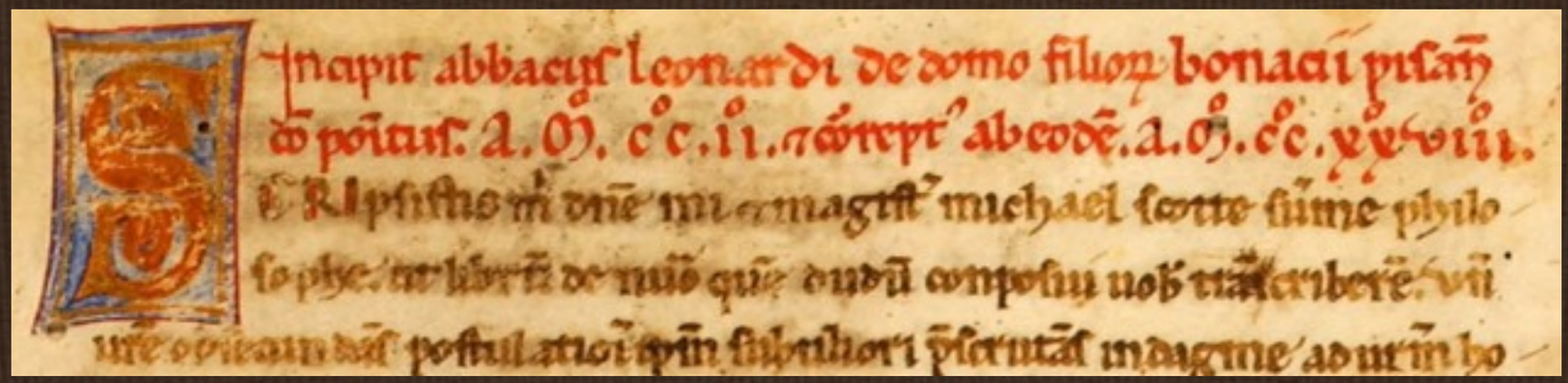

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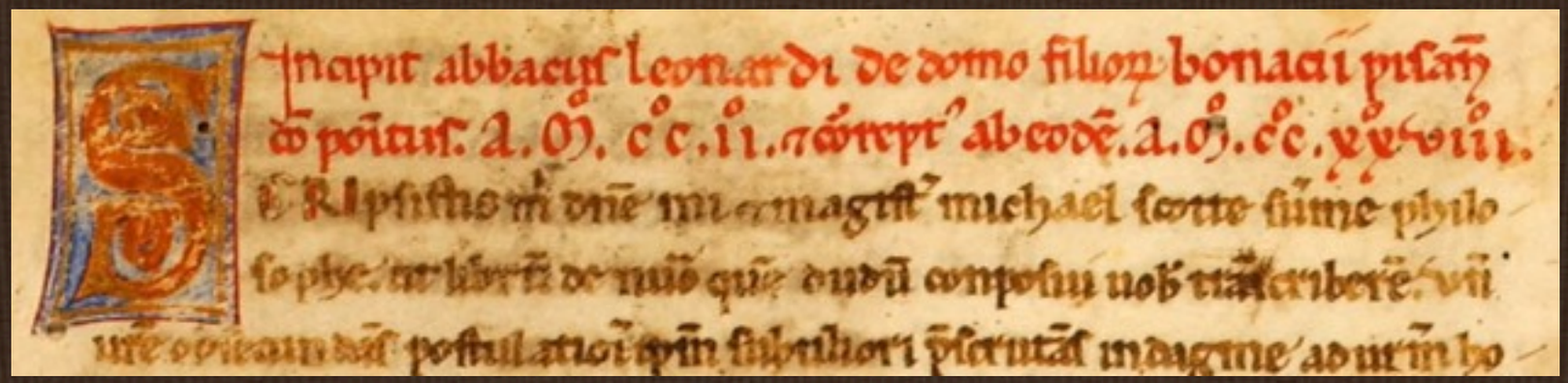

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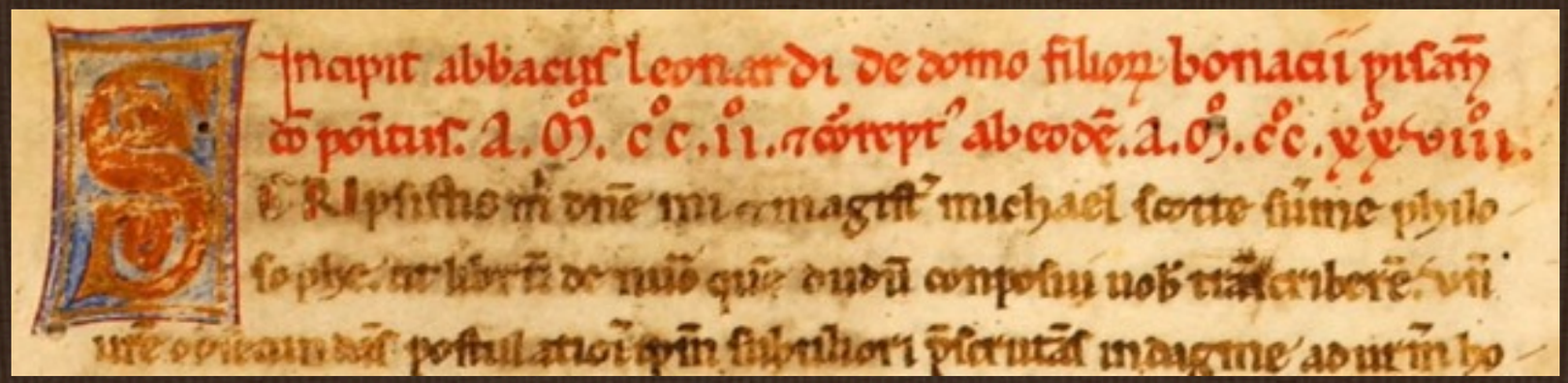

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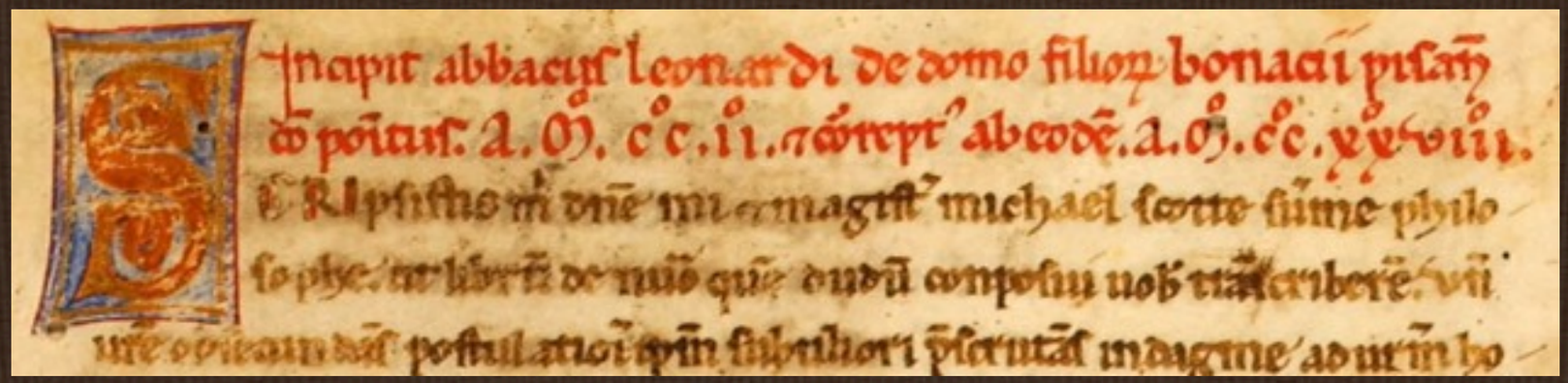

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- The "Fibonacci sequence" was so named by the French mathematician Edouard Lucas in the 1870s, after Libri coined the nickname Fibonacci.

The Fibonacci sequence

The "Fibonacci sequence", an unending sequence of whole numbers that begins

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, …

The rule for generating new numbers in the sequence is that each number is the sum of the two preceding numbers, so 1+1=2, 1+2=3, 2+3=5, etc.

This sequence arises when you solve a particular problem Leonardo gave in *Liber abbaci*:

How Many Pairs of Rabbits Are Created by One Pair in One Year.

A certain man had one pair of rabbits together in a certain enclosed place, and one wishes to know how many are created from the pair in one year when it is the nature of them in a single month to bear another pair, and in the second month those born to bear also.

The numbers of pairs each month are the Fibonacci numbers. You can read off the answer to Leonardo's problem: 377 pairs.

The problem and its solution date back well before Leonardo.

Leonardo's Real Legacy

The birth of modern finance (13th Century)

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Banking (*banca*)

Insurance (*polizza*)

International trading empires

Double-entry bookkeeping (Medicis)

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Leonardo's real legacy?

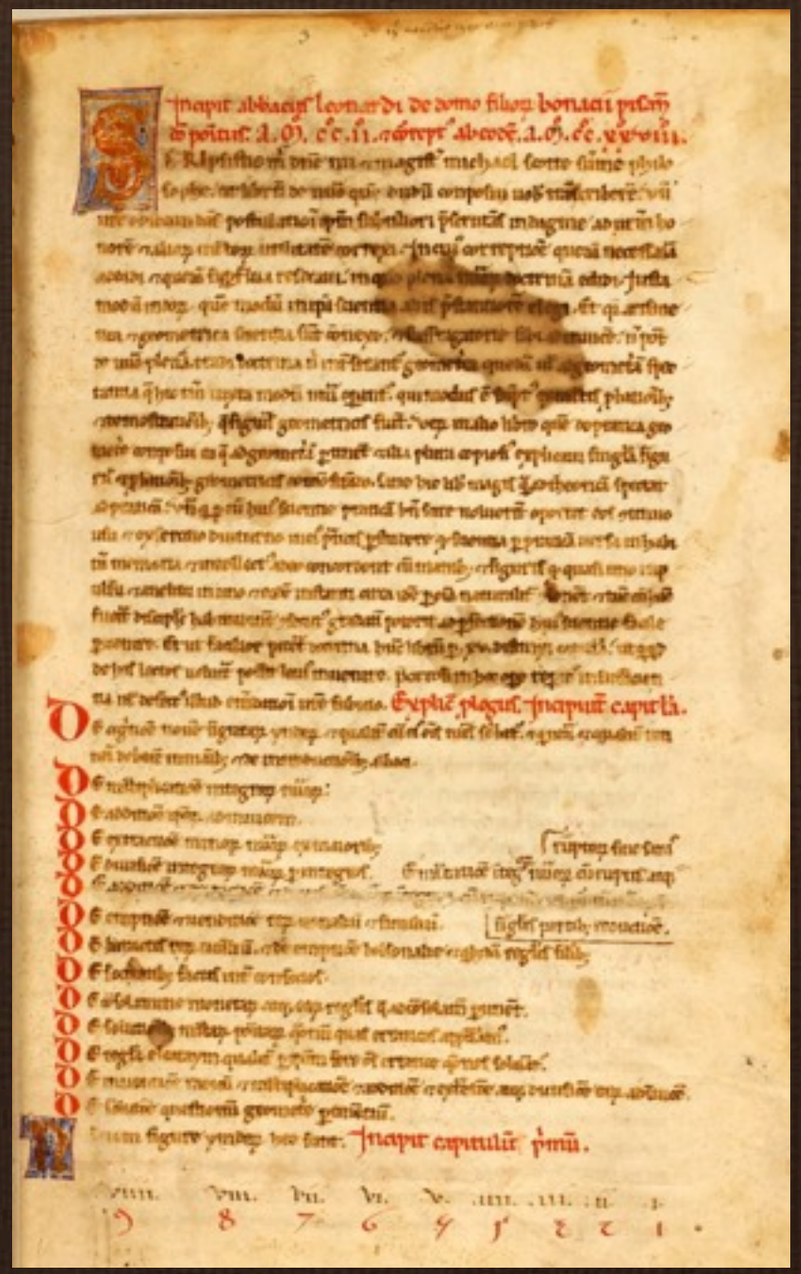
William N. Goetzmann, Edwin J. Beinecke Professor of Finance and Management Studies & Director of the International Center for Finance, Yale University:

"The five-hundred-year period following the appearance of *Liber abbaci* saw the development in Europe of virtually all the tools of financial capitalism that we know today: share ownership of limited-liability corporations, long-term government and corporate loans, liquid and active international financial markets, life insurance, life-annuities, mutual funds, derivative securities, and deposit banking. Many of these developments have their roots in contracts that were based on the mathematical analyses Leonardo introduced to Western Europe through *Liber abbaci*."

In particular, according to Goetzmann, evidence in *Liber abbaci* suggests that Leonardo was the first to develop present-value analysis for comparing the economic value of alternative contractual cash flows. (The present value criterion is now used by virtually all large companies in capital budgeting decision making. The modern present-value formula was developed by economist Irving Fisher in 1930.)

William N. Goetzmann, Fibonacci and the Financial Revolution, in William N Goetzmann and K Geert Rouwenhorst (eds), *Origins of Value: The Financial Innovations that Created Modern Capital Markets*, Oxford University Press, 2005

Books Leonardo wrote



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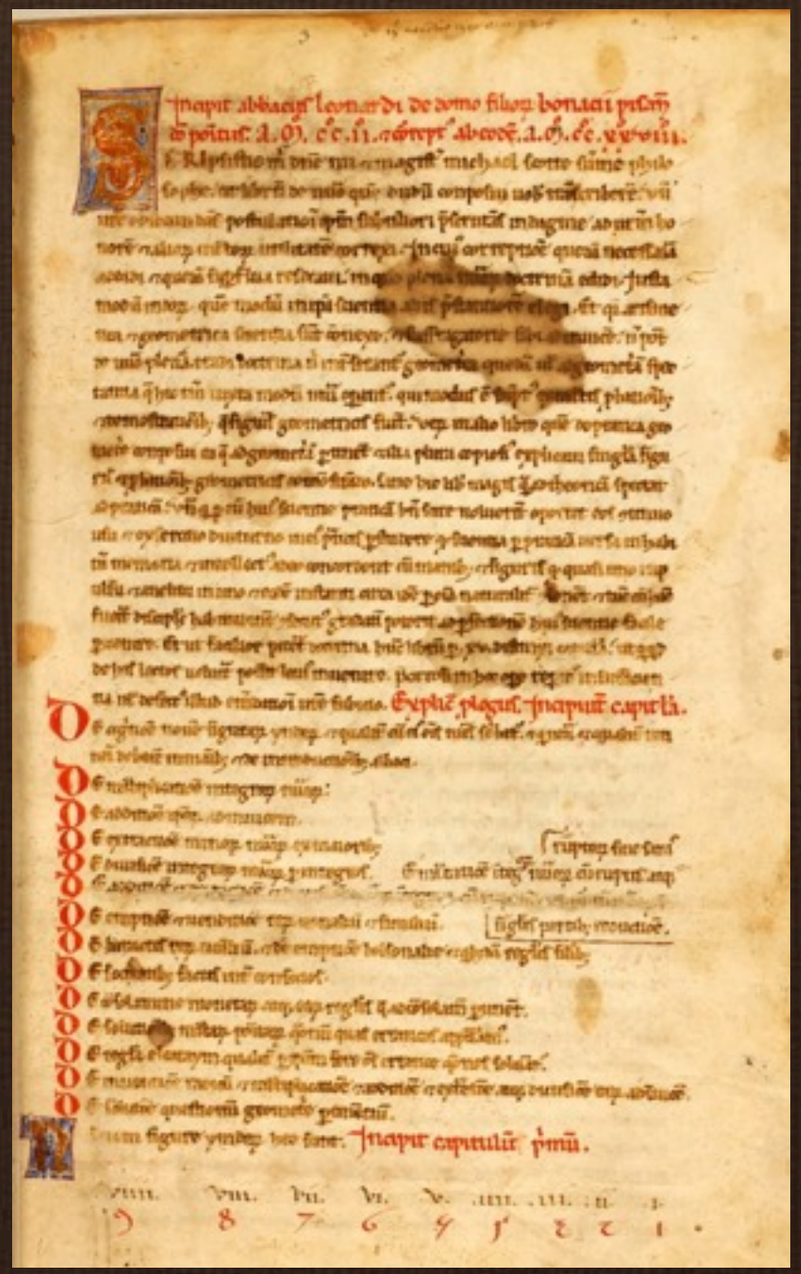

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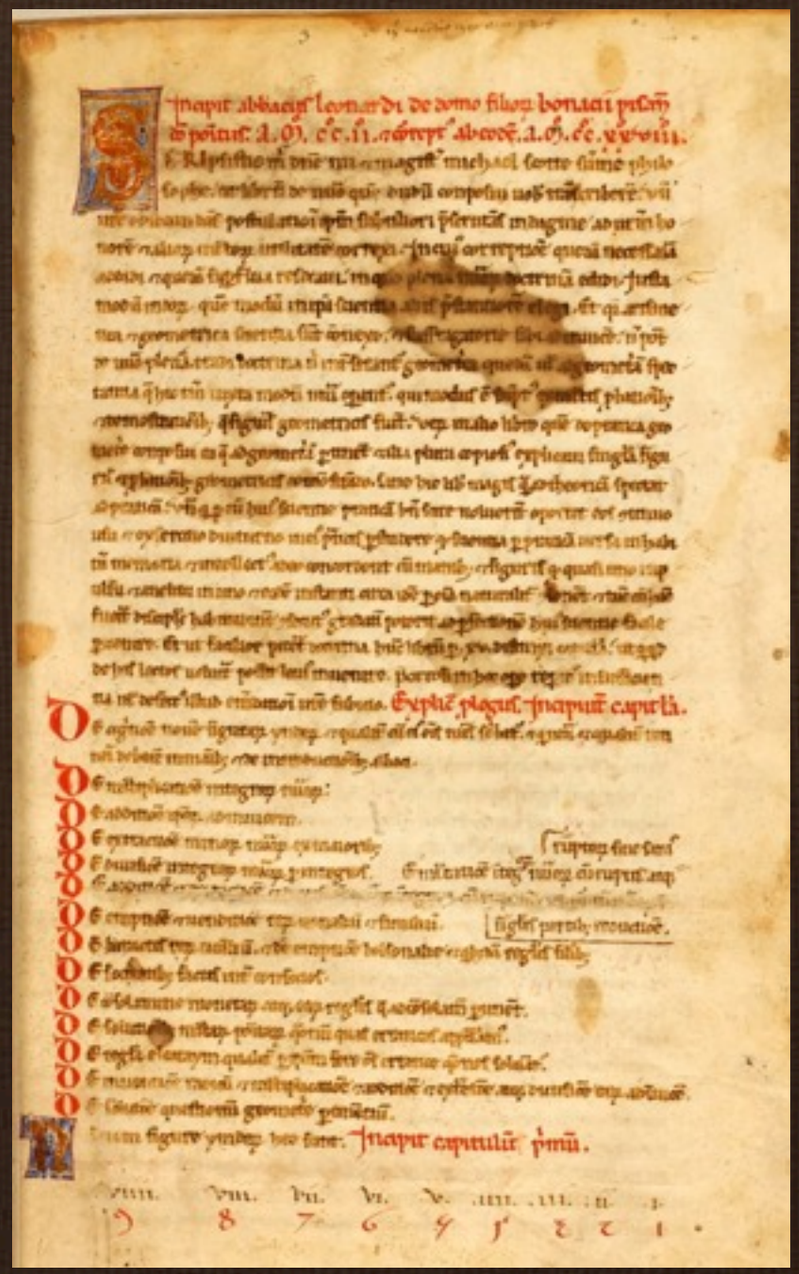

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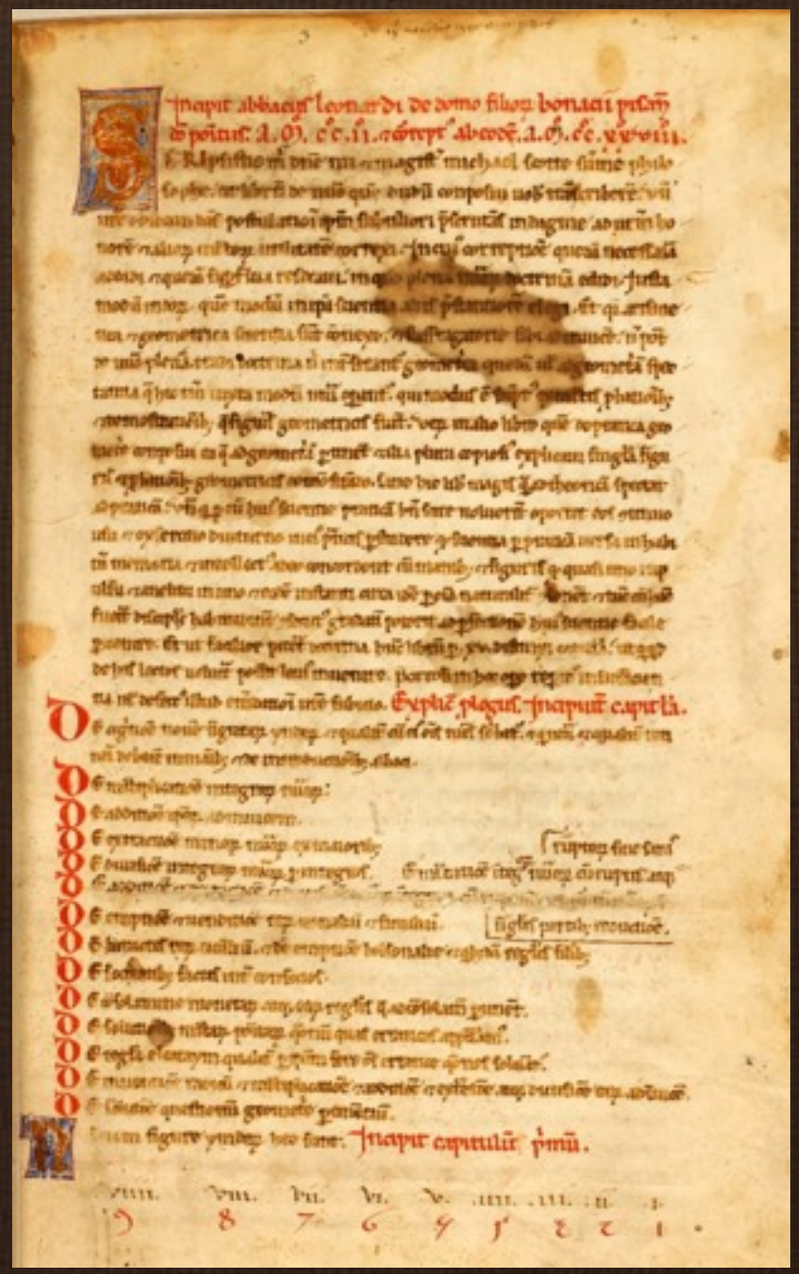

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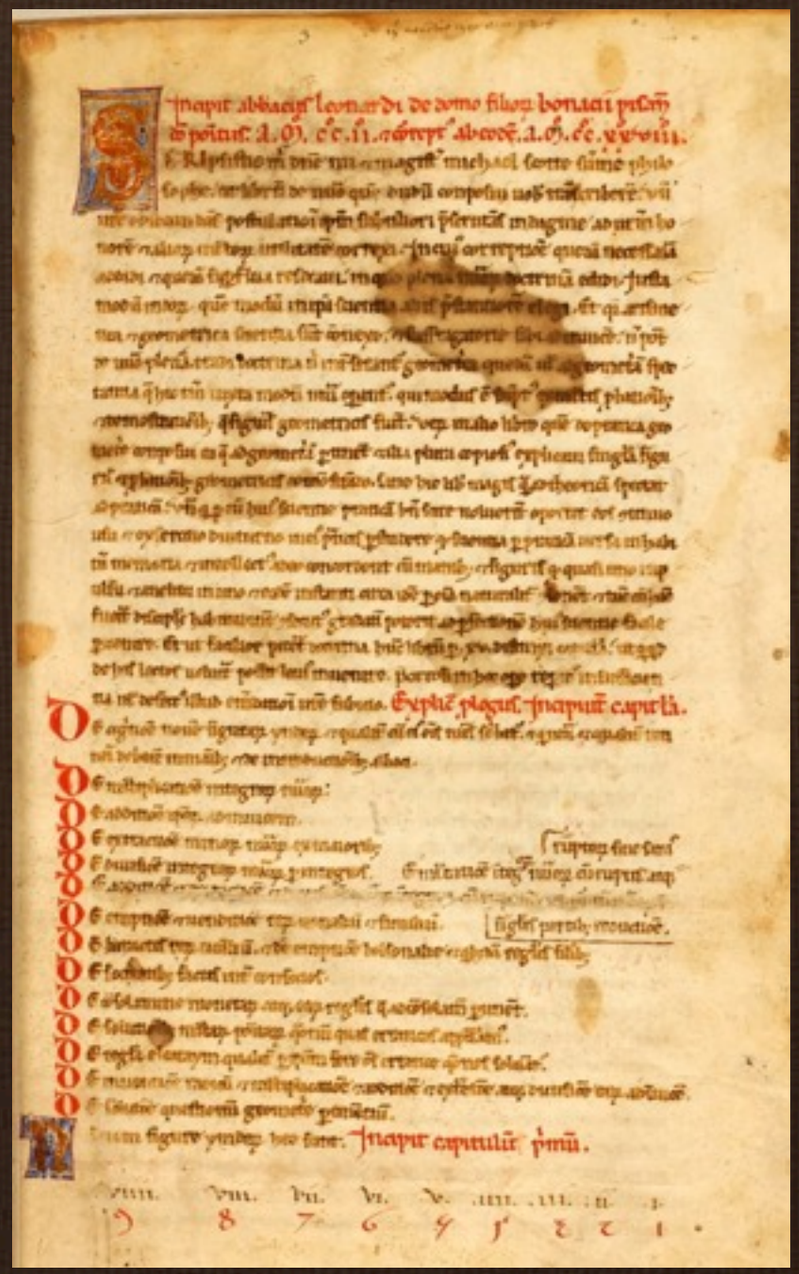

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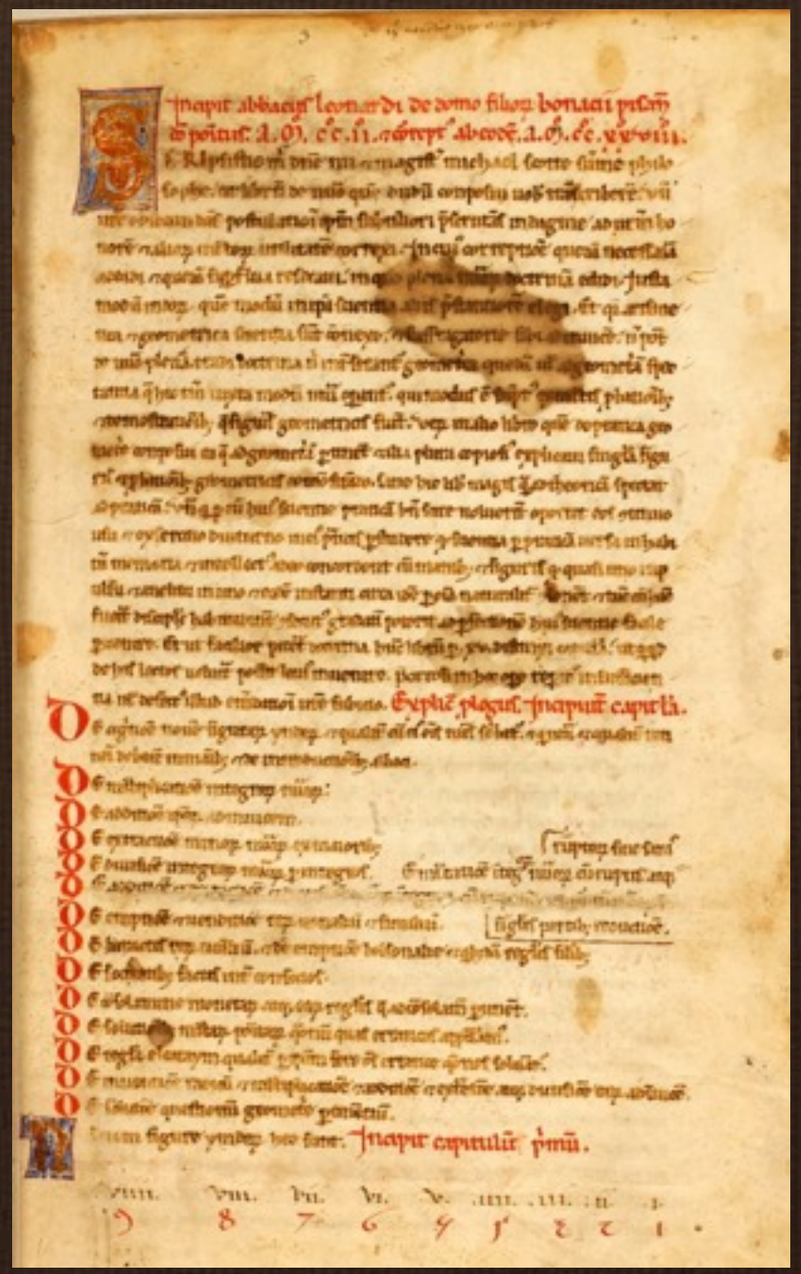

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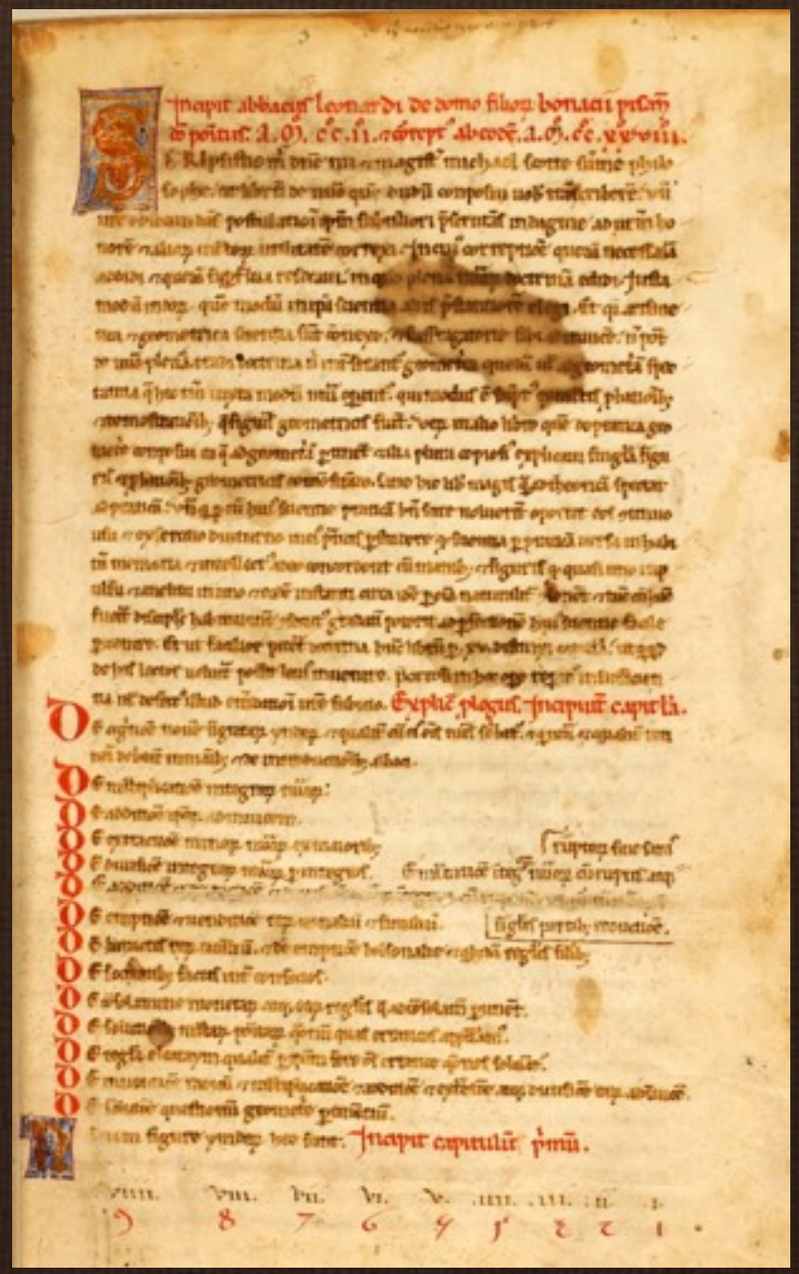

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1326-1350: 10	1351-1375: 6
1376-1400: 19	1401-1425: 16
1426-1450: 39	1451-1475: 56
1476-1500: 66	After 1501: 30+

The first personal computing revolution

- 1202: First edition of *Liber abbaci*.
- Abbacus books (discovered in 1960s)
- 250 have survived:

  Before 1300: 1 — 1301-1325: 8

  1326-1350: 10 — 1351-1375: 6

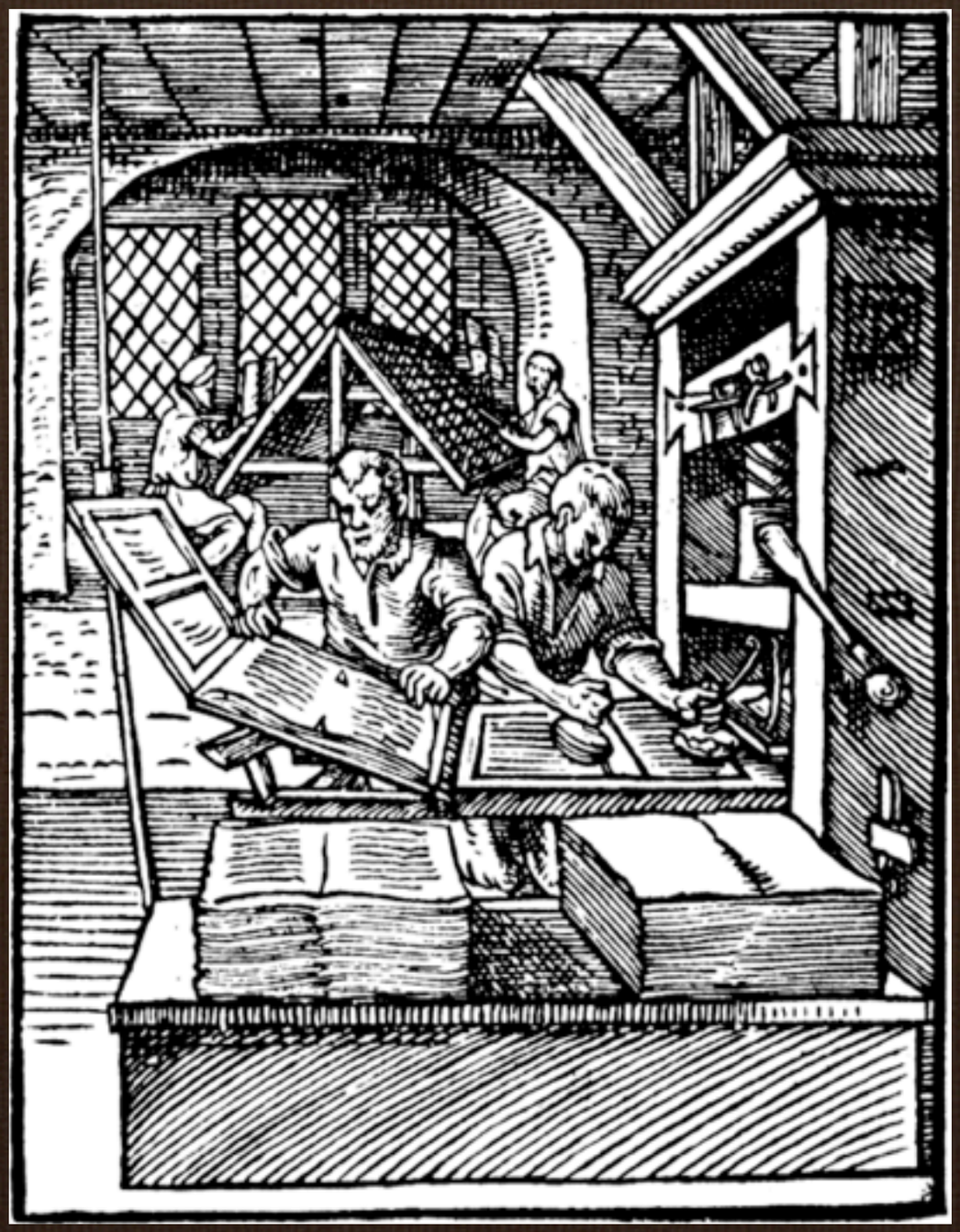
  1376-1400: 19 — 1401-1425: 16

  1426-1450: 39 — 1451-1475: 56

  1476-1500: 66 — After 1501: 30+
- Abbacus schools (earliest known in Verona in 1294)
- 1340-1510: records of 20 in Florence alone

Why was Leonardo forgotten?

A victim of new technology



Printing press, 1436

The sole record

Luca Pacioli, 1494, *Summa de arithmetica, geometria, proportioni et proportionalità*.

And since we follow for the most part Leonardo Pisano, I intend to clarify now that any enunciation mentioned without the name of the author is to be attributed to Leonardo.

Ad illustrissimum Principem Gui. Vbaldum Vrbini Ducē Montisfe
retri: ac Durantis Comitem. Grecis latinisq; litteris Ornatissimum: ac Ma
thematice discipline cultorem ferventissimum: Frater Luce de Burgo san
cti Sepulchri: Ordinis minorū: ac sacre Theologie Magistri. In artes arith
metices ac Geometrie. Prefatio.

A quantita Magnanimo Duca:
e si nobile ⁊ excellēte cosa che molti philosophi per que
sto luoco giudicara ala substantia para: cōsia coeterna.
Peroche luno cognosciuto per verū modo alcuna cosa
in rerū natura senza lei nō potere esistere. Per la qual co
sa de lei intēdo (cō lauto de colui che li nostri sensi reggi)
tractare: non che per altri prischi e antichi philosophi
nonne sia copiosamente tractatoce in theorica e pratica.
Ma per che lor dicti gia ali tempi nostri sonno mol
to obscurice vsanoli male apresso ale pratiche vulgari ma
le applicati: vsche i loro operationi molto variano: e con
grandi elaborioli affanni mettano in opera: si de numeri cōno de misure: vnde vi
ci parlando non intendo se non quāto che ala pratica e operare sia mestiero: mes
tandoci secōdo duoghi opportuni ancora la theorica: ecausa de tale operare: si de nu
meri cōno de geometria. Ma prima accio meglio q̄llo che seguita se habia apprehē
dere: essa quantita duali trouo secōdo el nostro proposito: diuidendola acciascun suo
membro assegnaremo sua propria e vera diffinitione e descriptione. E alora poi se
quira quello che Arist. dicia in secundo poster. Hec enim maxime sciuī aliquid cum
habemus finem quid est ⁊c.

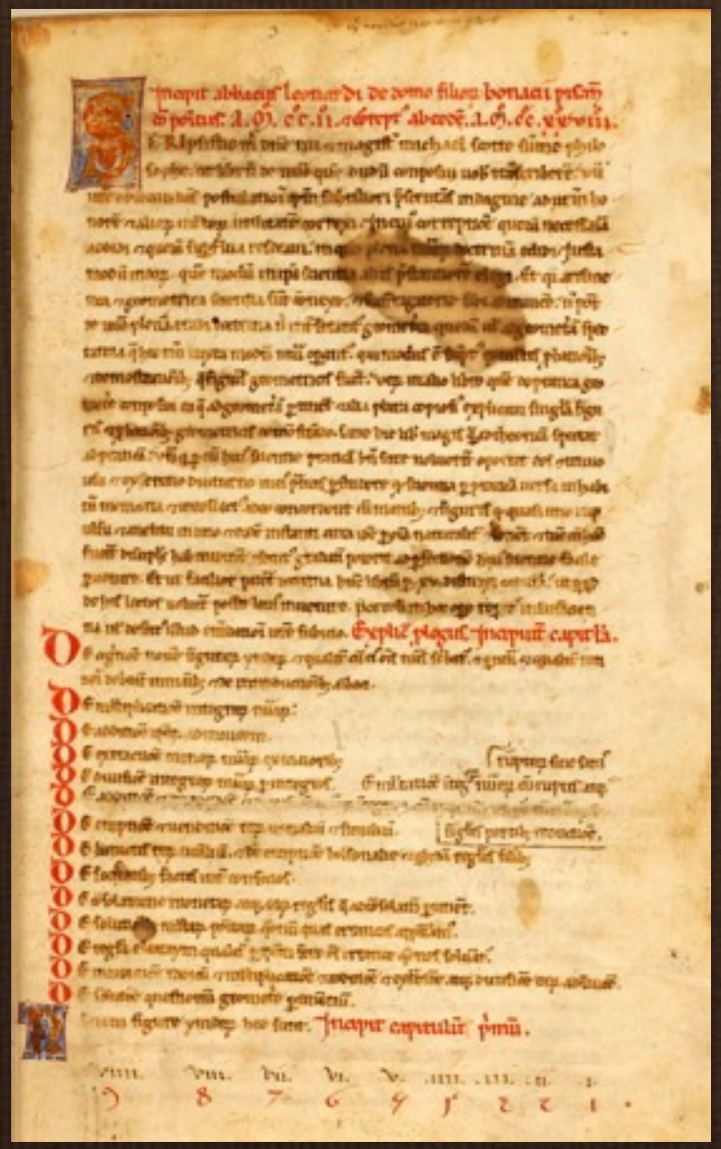
Diffinitione ⁊ dutto diuerse ⁊ contenute quantitatis articulus primus prime
distinctionis.

Dico adōca. La quātita essere imediate bimembre: cioe continua e discreta.
La continua e quella le cui parti fanno copulare e giongere a certo termine
cōmune: cōme sōno legni: ferro: e taca ⁊c. La discreta ouer sanēte nume
ro: e q̄lla le cui parti nō sōno gionte adalcuno termine cōe: cōme 1. 2. 3. ⁊c.
Dicte prima dela discreta cioe del numero: e poi dela continua cioe geometria: quā
to alo intento aspecta diuaramente tractaremo.

Diffinitio numeri proportionis articulus secundus.

Numero (secondo dicano philosophi) ena multitudine de vnita cō
posta: et q̄lla vnita nō e numero: ma ben principio de q̄lcun numero: ede
q̄lla mediante laqle ogni cosa e detta essere vna. E secōdo elucerin Boetio i
suamusica e lay vna q̄lcū numero i potētia: e passi i la sua arithmetica Re
gula e fondamento dogni numero la pella. La qual pia magnificandola in le cose na
turali disse in quello che fa de vnitate ⁊ uno. Omne quod est: ideo est: quia vnum nu
mero est. E ne ancora el numero in infiniti membri diuiso: per quel che esso Aristo.
dice: cioe. Siquid infinitum est: numerus est. E per la terza petitione del septimo de
Euclide: la sua serie in infinito potere procedere: et quocūq; numero dato: vari pō
maior: vnita atem addendo. Ma a noi piglaremo quelle parti a noi piu note e accomo
date. E pero dico con q̄lchari alcuno effer primo: ede quello che solo vala vnita e nu
merato: e non ha altro numero: che integralmente aponto lo parta. Altro e detto cō
posto: ede quello che ha altro numero e mesurato: ouero numerato. Exēplum primi
Cōmo. 3. 7. 11. 13. e 17. ⁊c. Exēplū secūdi. Cōmo. 4. del qual lo mesurato numero e 8.
del. 2. e 4. E. 12. 14. 18 e simili: tutti sōno detti numeri compositi: nō solo che contino

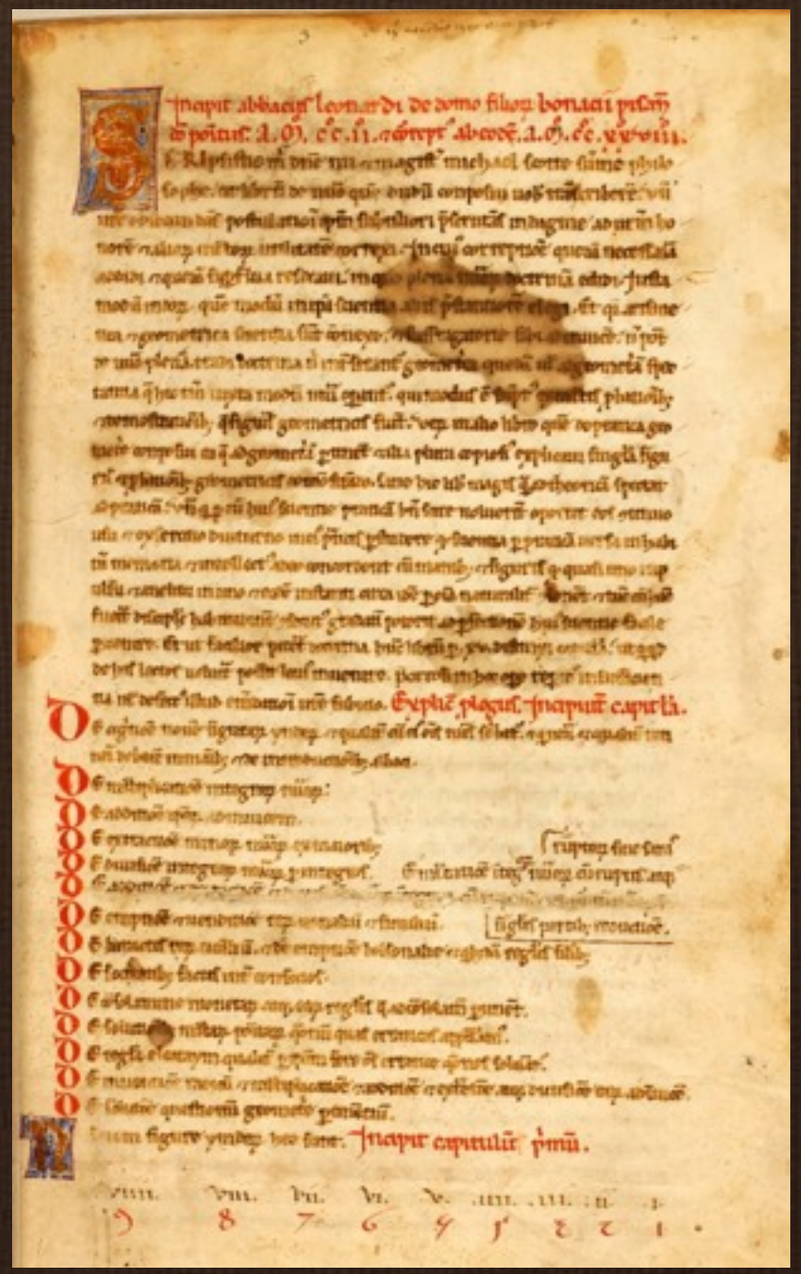
Who started the revolution?



?

Books Leonardo wrote

- The first edition of *Liber abbaci* has not survived.
- Leonardo completed a second edition in 1228, and several late 13th or early 14th century copies exist.
- He wrote a shorter, simpler account of Hindu-Arabic arithmetic, *Libro di minor guisa* ("Book in a smaller manner") aimed at merchants, which modern historians think was the work most responsible for popularizing the new methods in Europe, but no copies were found
- *Practica geometriae* (1220) is a geometry textbook.
- *Flos* (1225) presents Leonardo's solutions to a series of challenge problems posed to him in a public display in the Court of the Emperor Frederick II.
- *Liber quadratorum* ("Book of Squares", 1225) is an impressive number theory book which, among other things, examines methods to find Pythagorean triples.



The first page of a copy of the 1228 edition of *Liber abbaci* kept in the Siena Public Library, believed to date from the late 13th Century.

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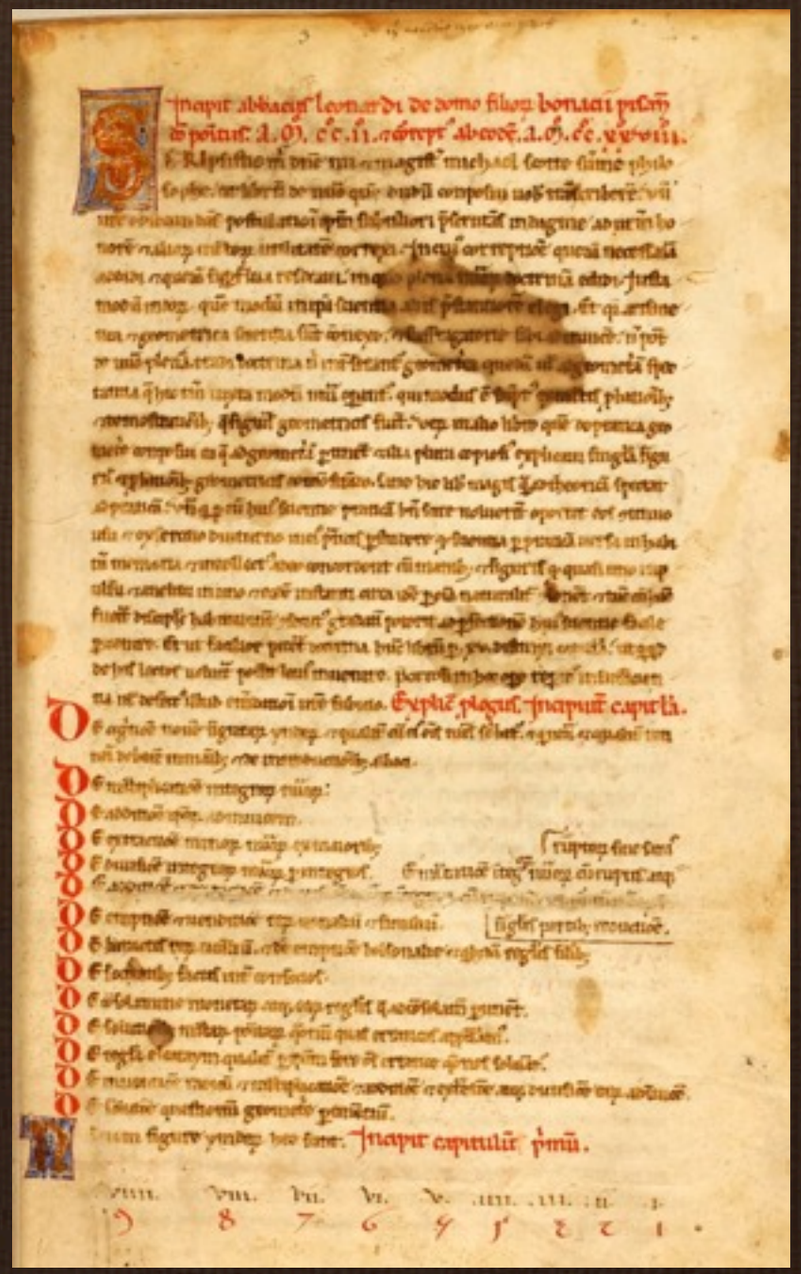

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The Missing Link – 2003

The Missing Link – 2003

Prof Rafaella Franci

The Missing Link – 2003

Via de' Ginari 10, Florence

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Riccardiana Library

Prof Rafaella Franci

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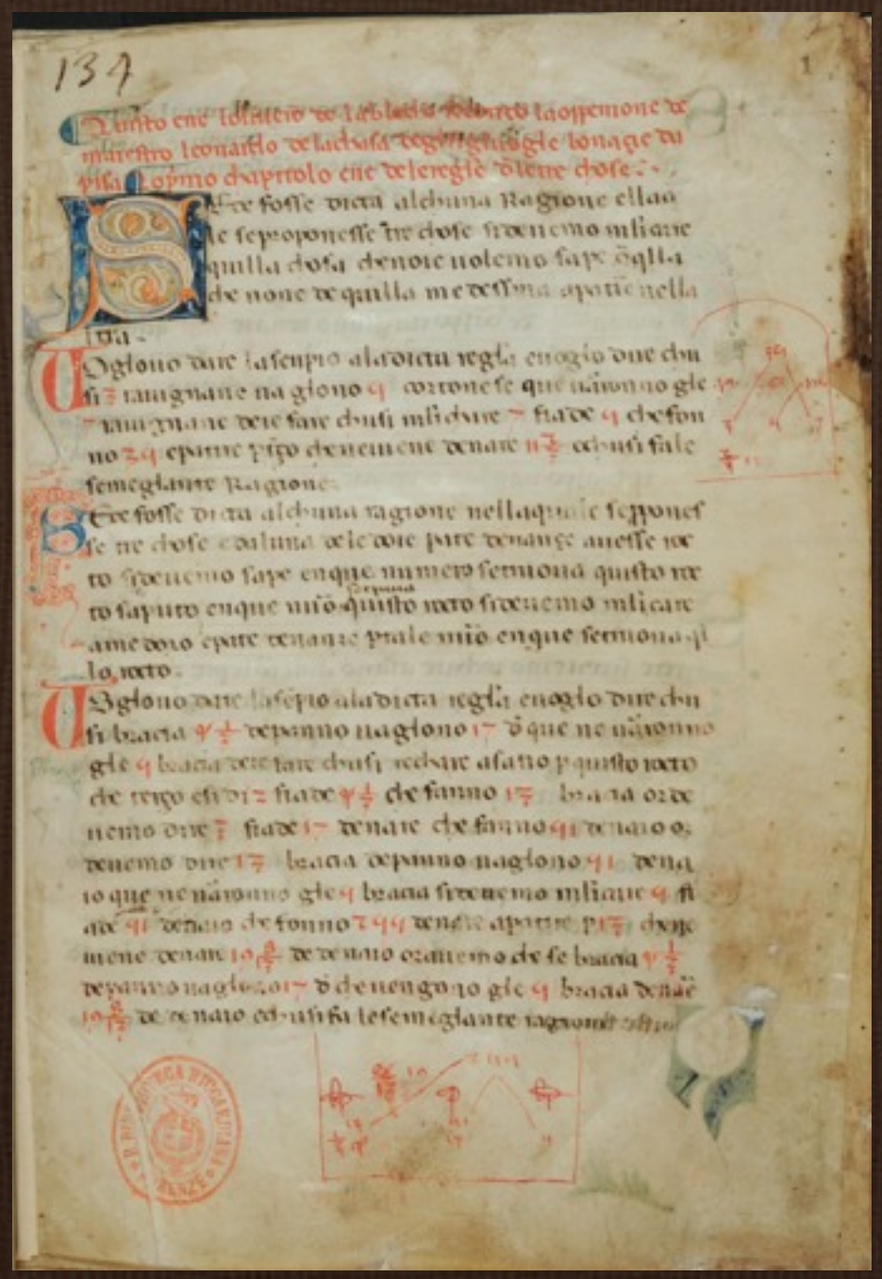
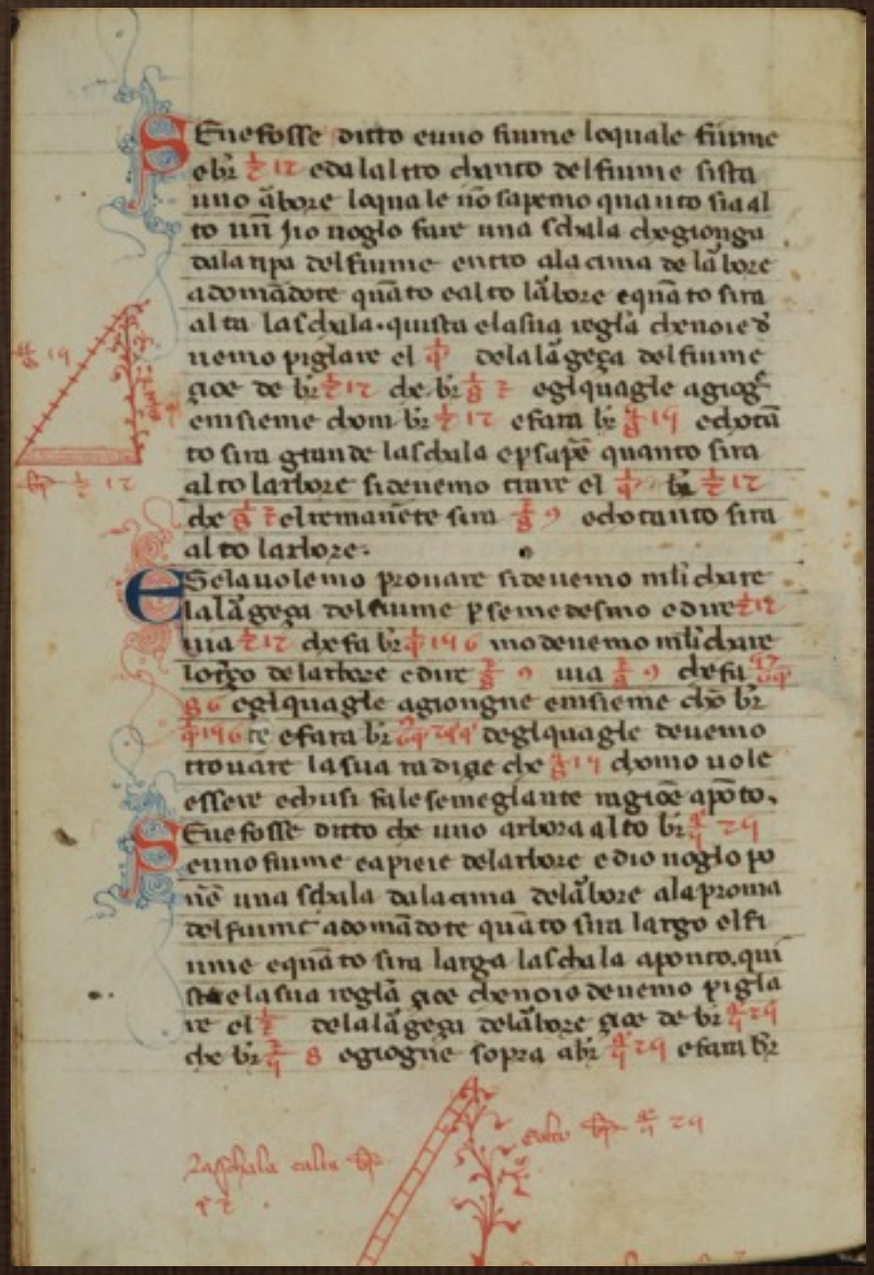
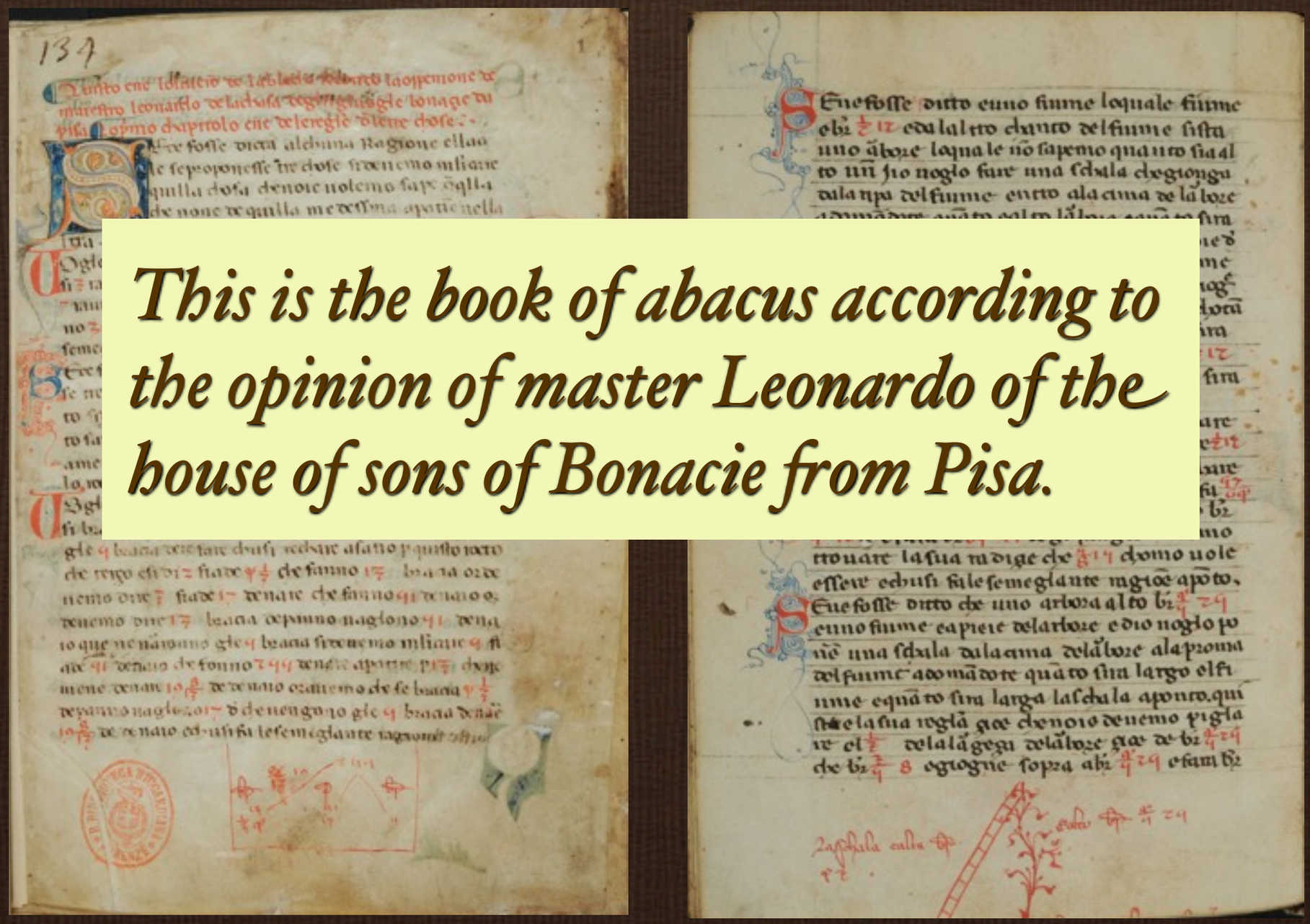




Codex 2404, Umbrian author, ca 1290

The Missing Link



This is the book of abacus according to the opinion of master Leonardo of the house of sons of Bonacie from Pisa.

Codex 2404, Umbrian author, ca 1290

The birth of modern finance (13th Century)

Banking (*banca*)

Insurance (*polizza*)

International trading empires

Double-entry bookkeeping (Medicis)

The birth of modern finance (13th Century)

Banking (*banca*)

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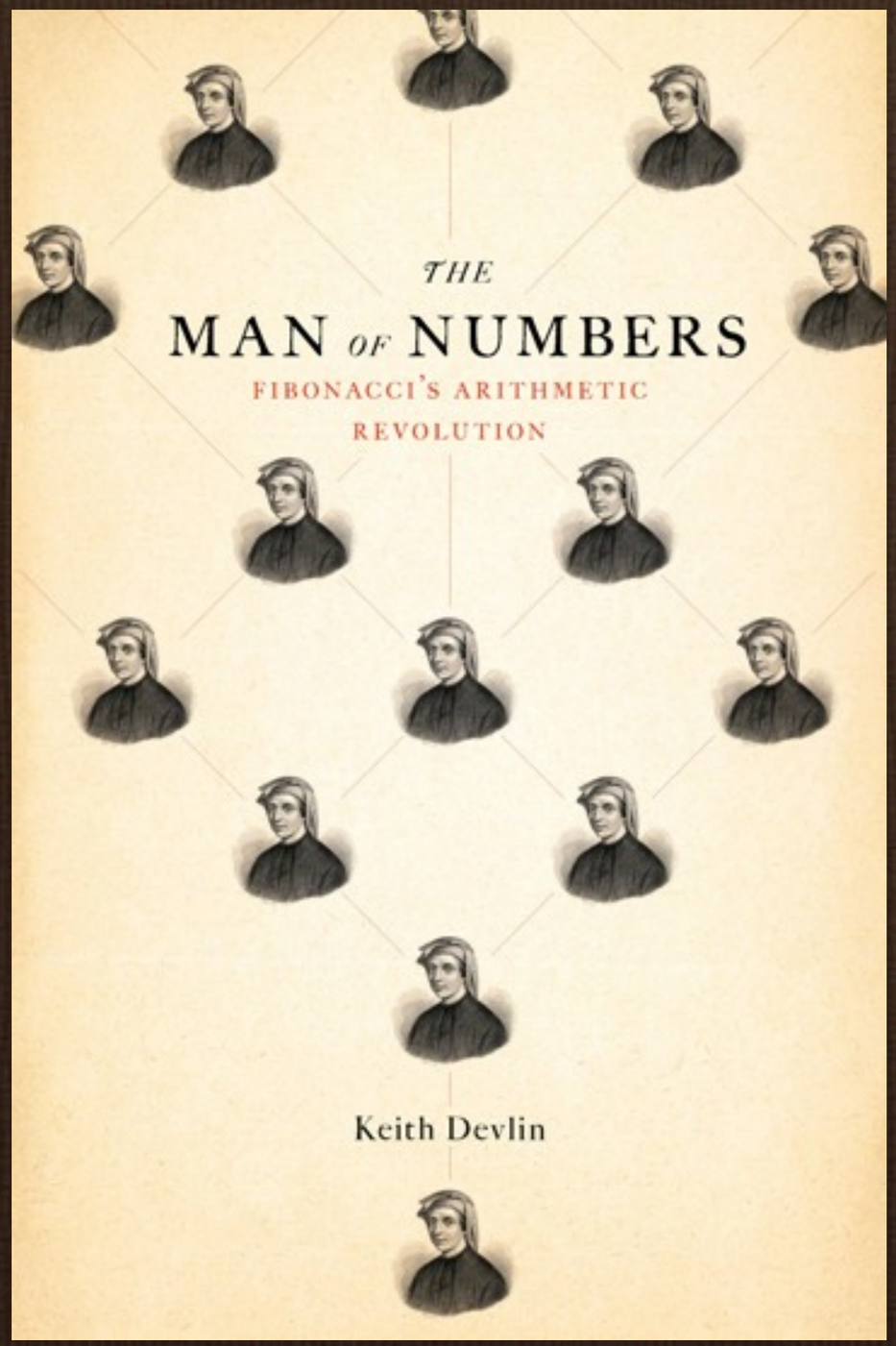
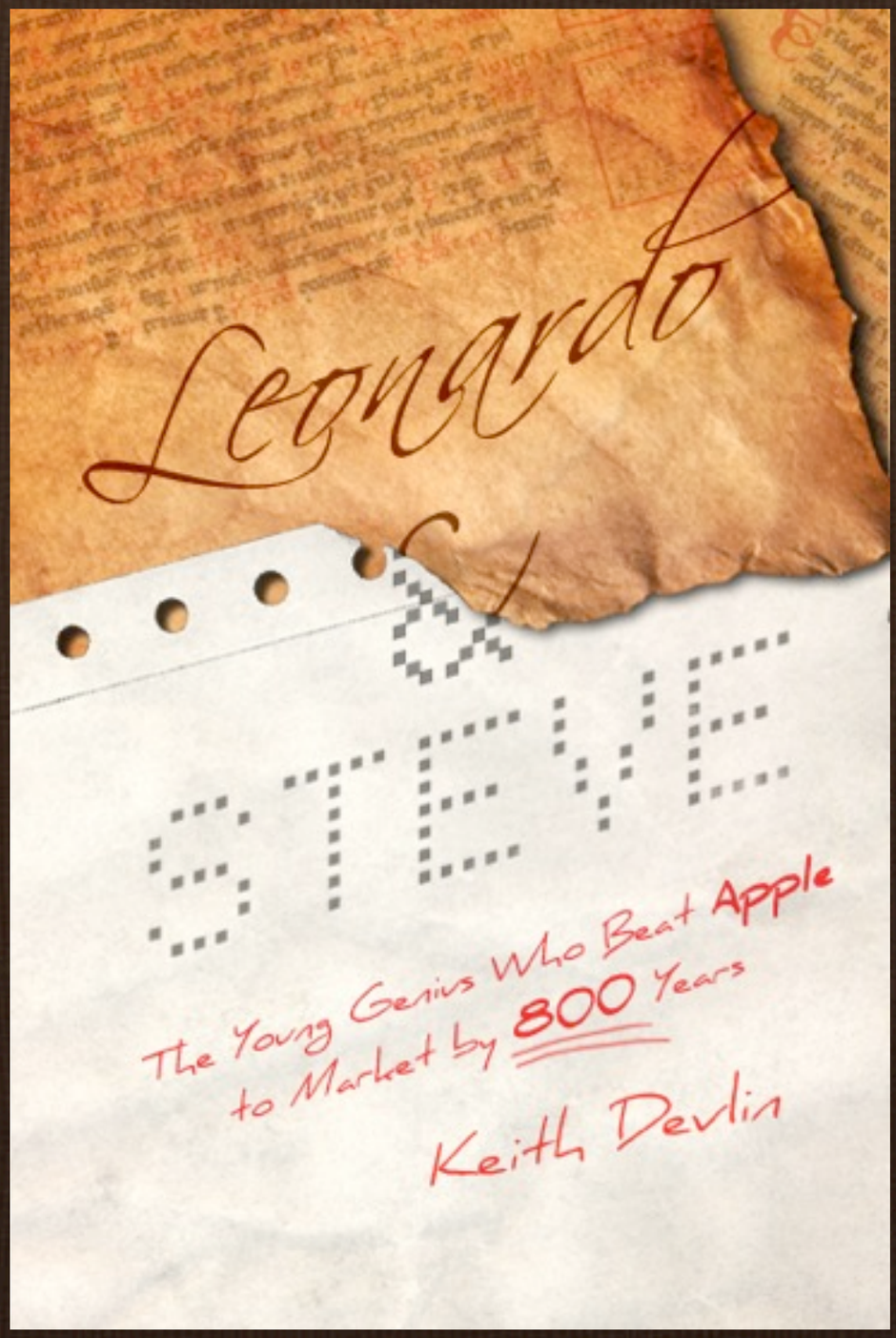
My Leonardo books

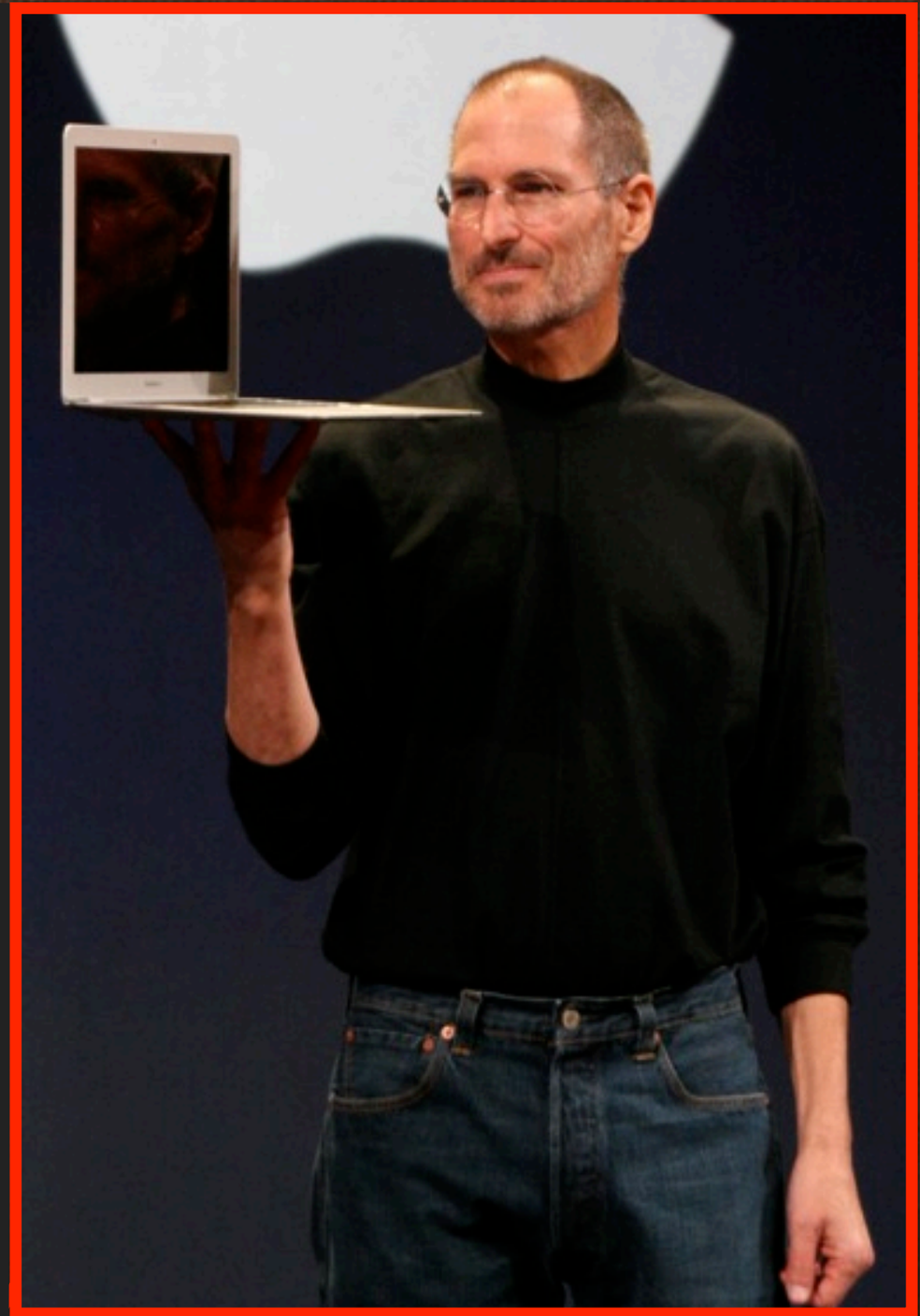


New York: Walker & Co.



e-book original

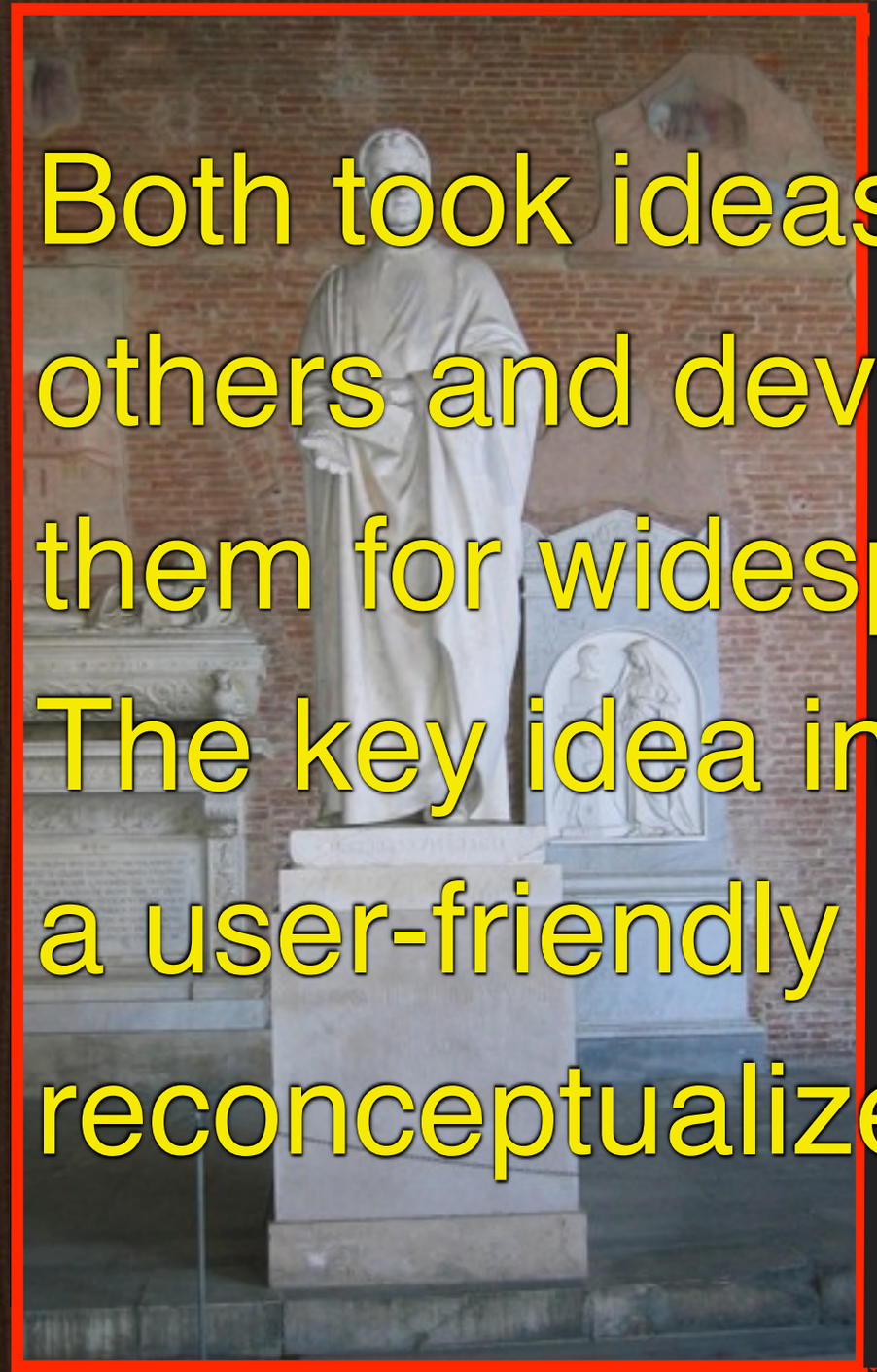
The Comparison



The Comparison

- Both took ideas developed by others and developed/marketed them for widespread use.

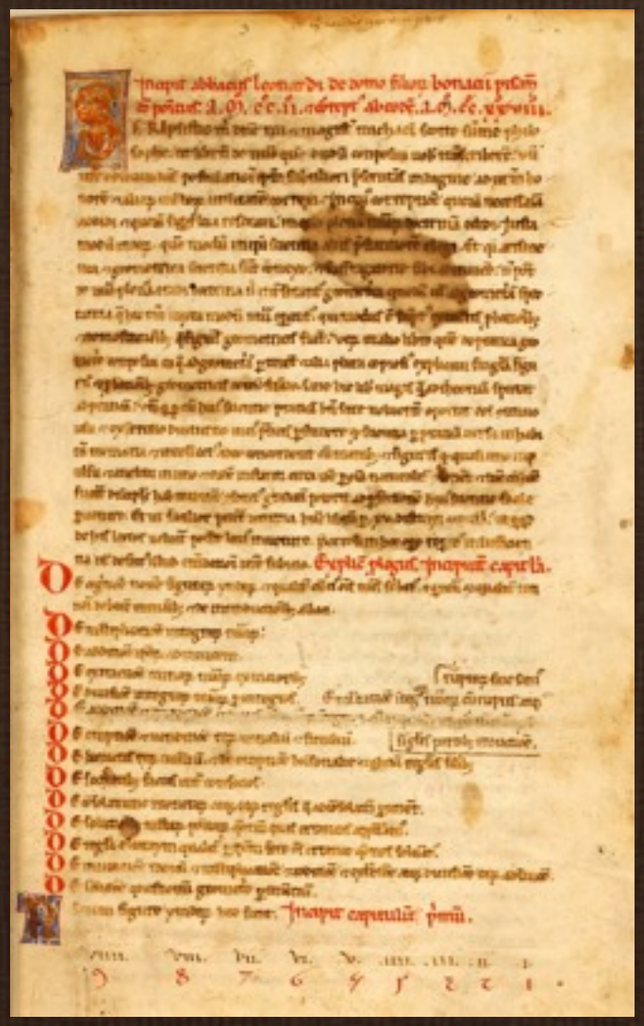
The Comparison



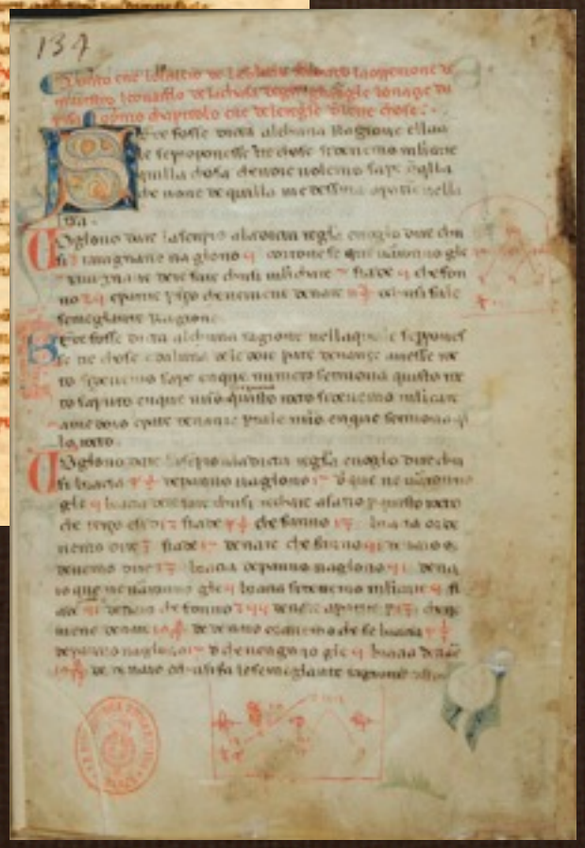
- Both took ideas developed by others and developed/marketed them for widespread use.
- The key idea in both cases was a user-friendly interface that reconceptualized the activity.

Marketing savvy

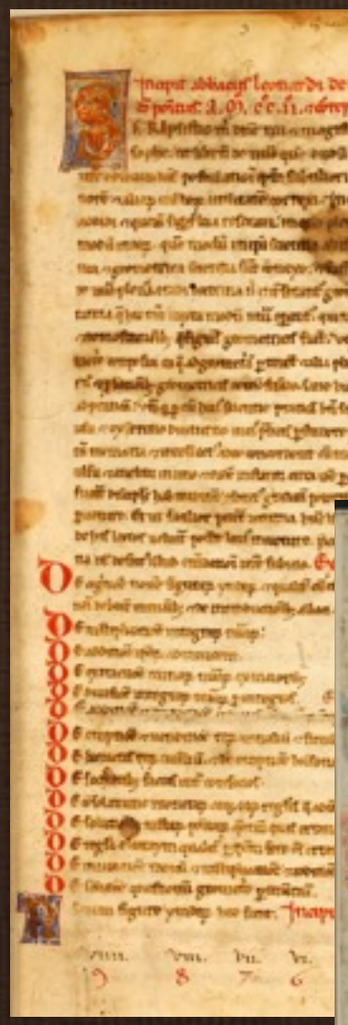
Marketing savvy

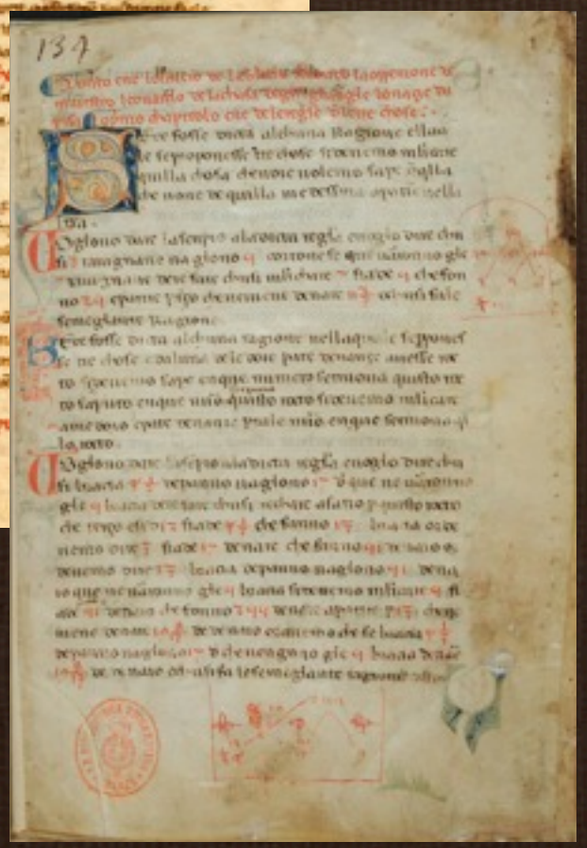


Marketing savvy

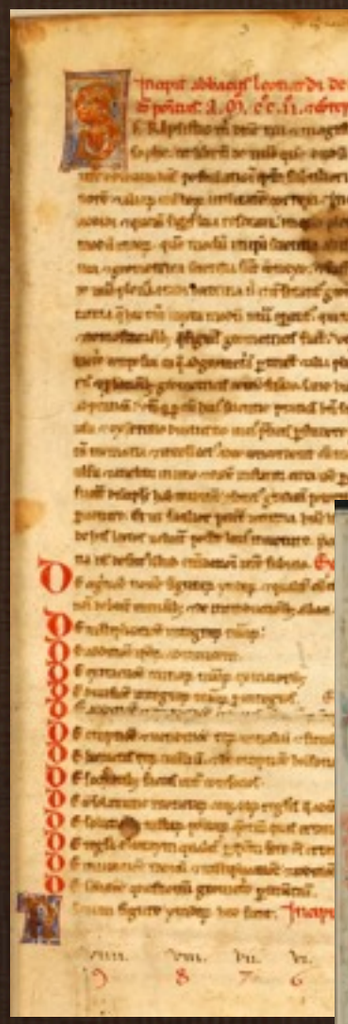


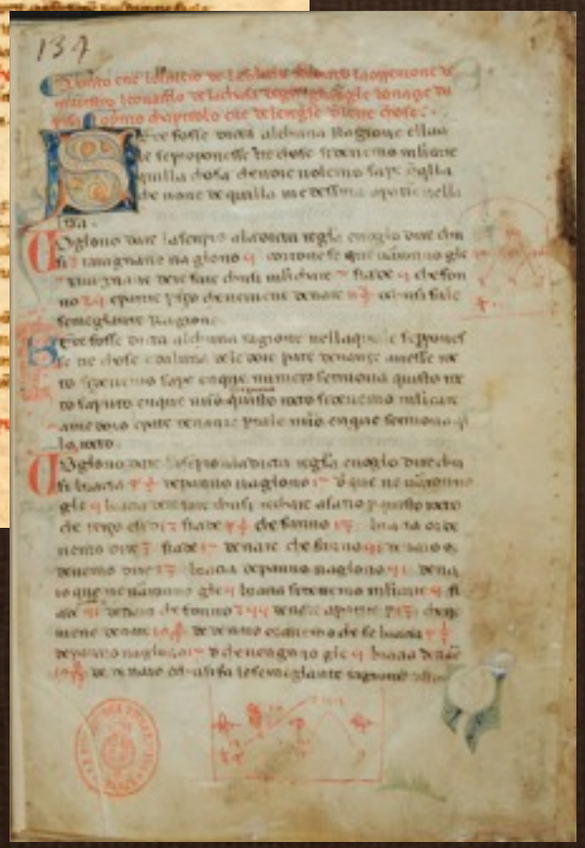
Marketing savvy





Marketing savvy





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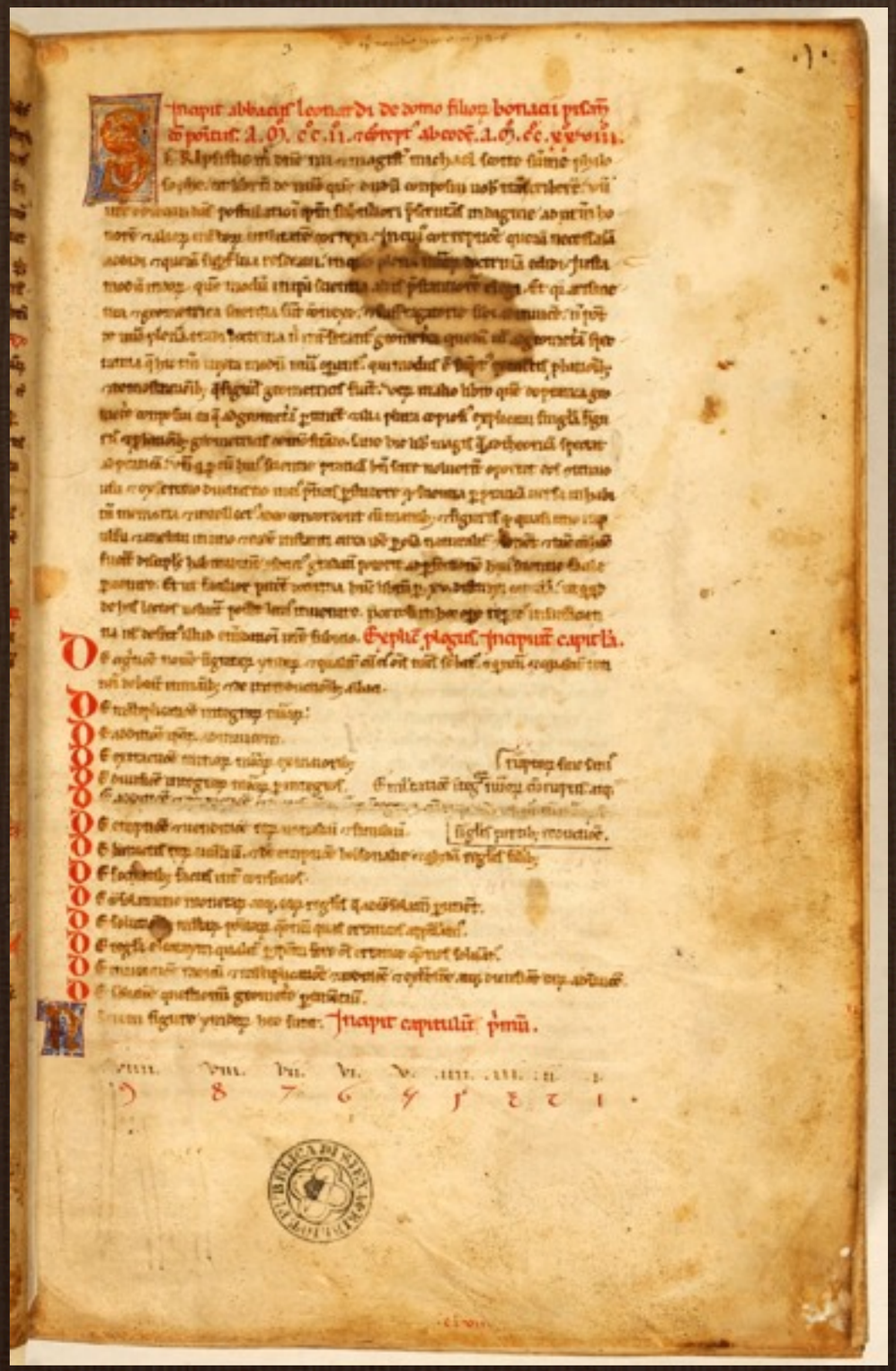

3a

5a

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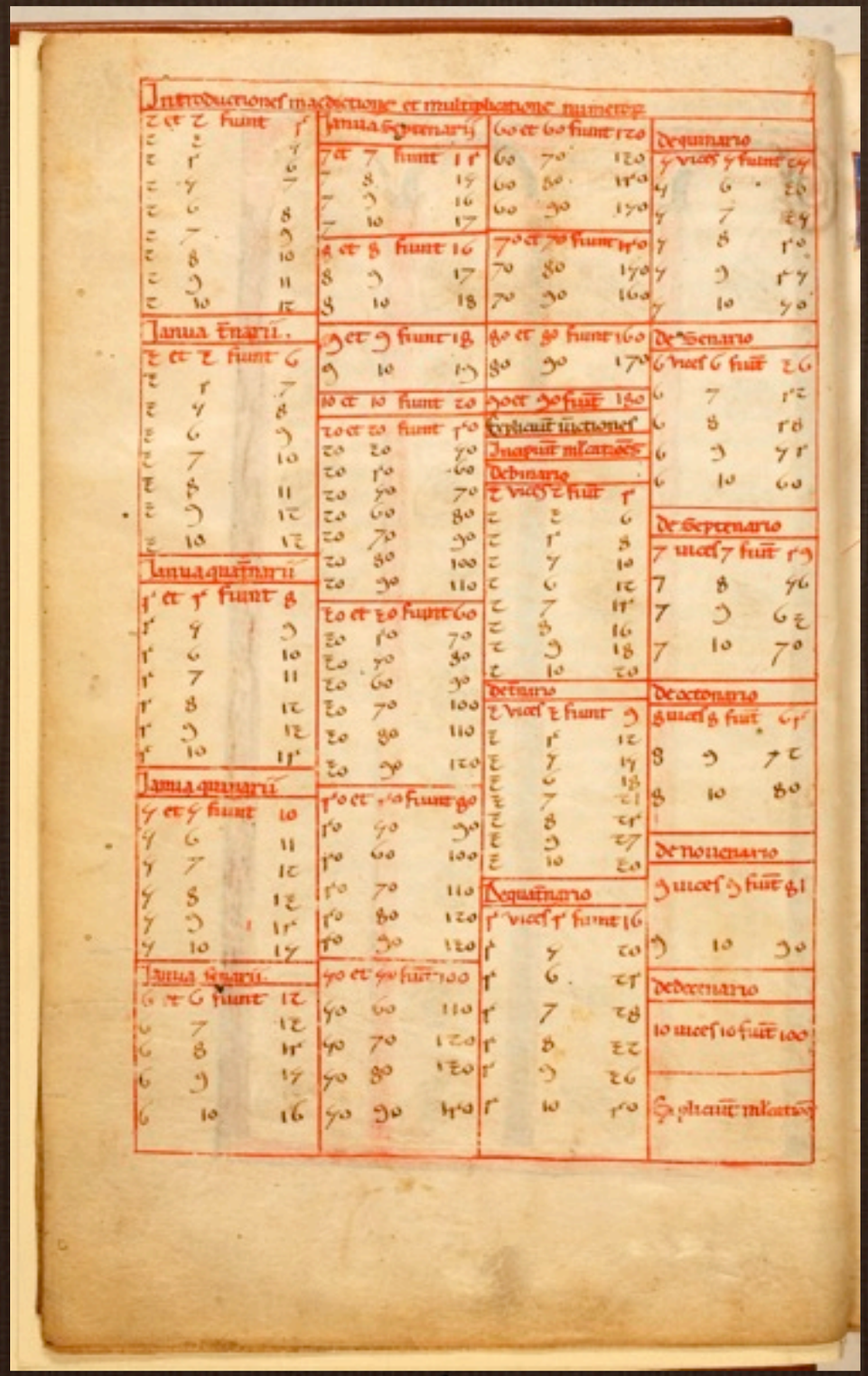

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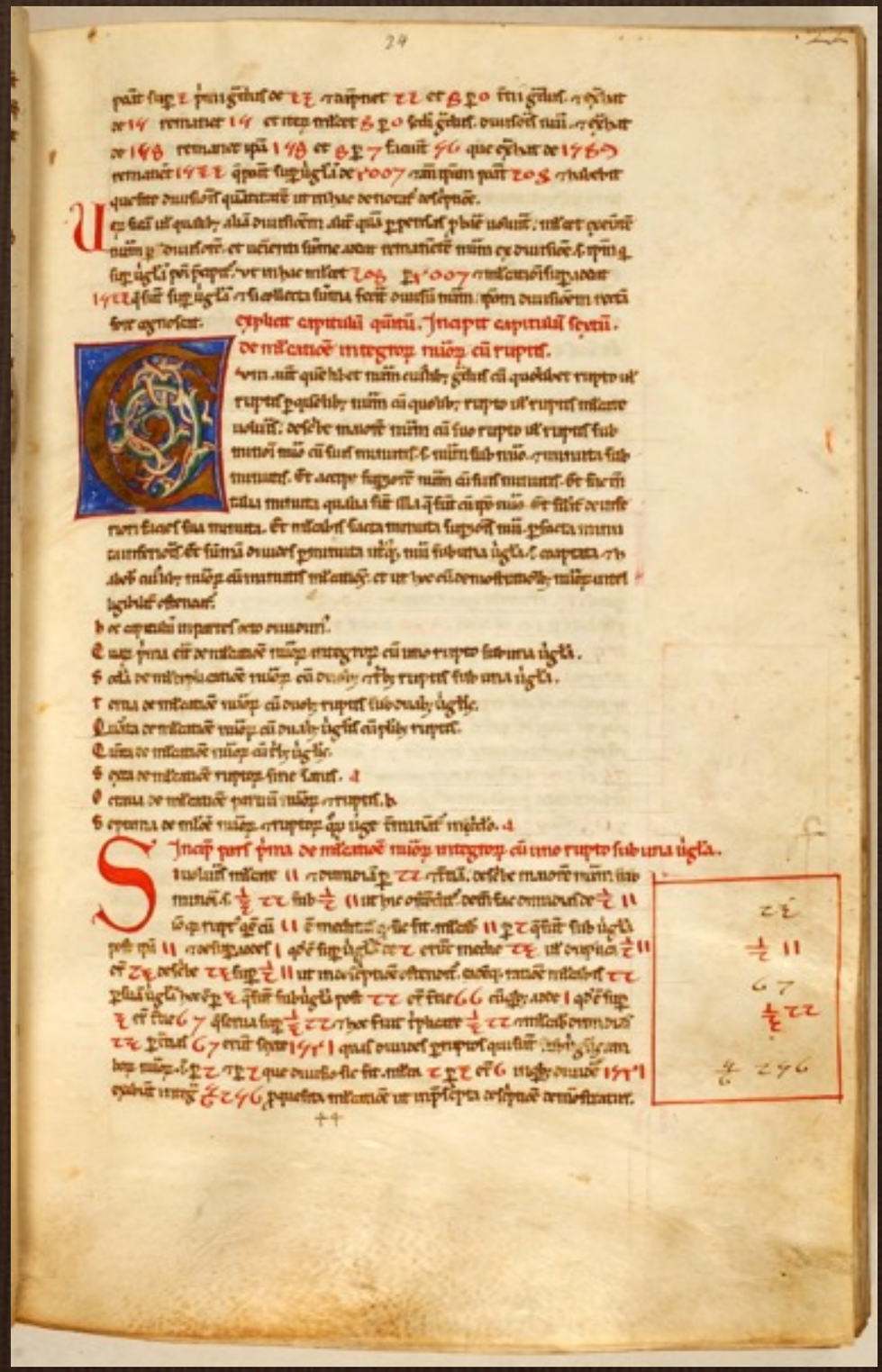

24a

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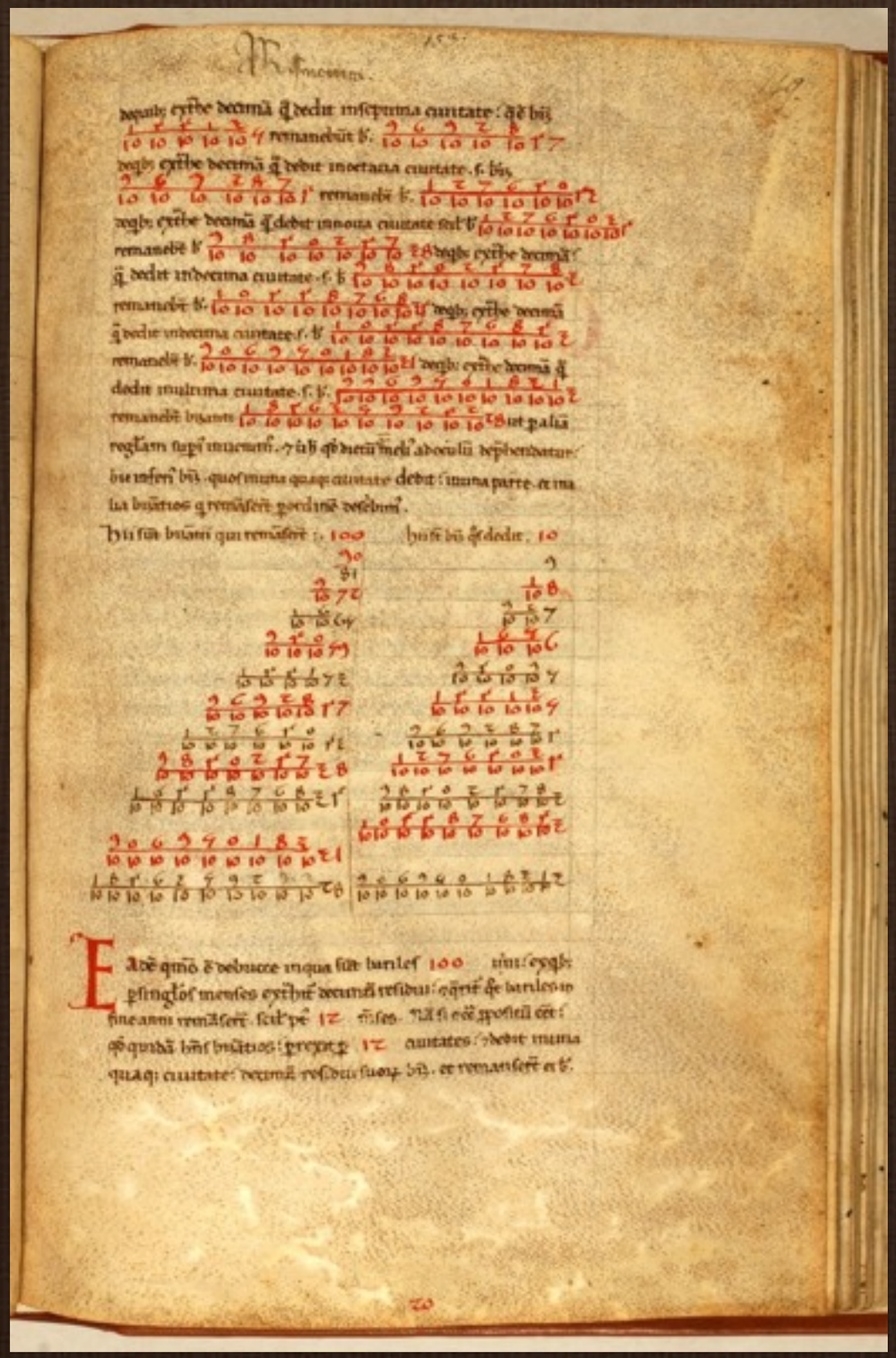
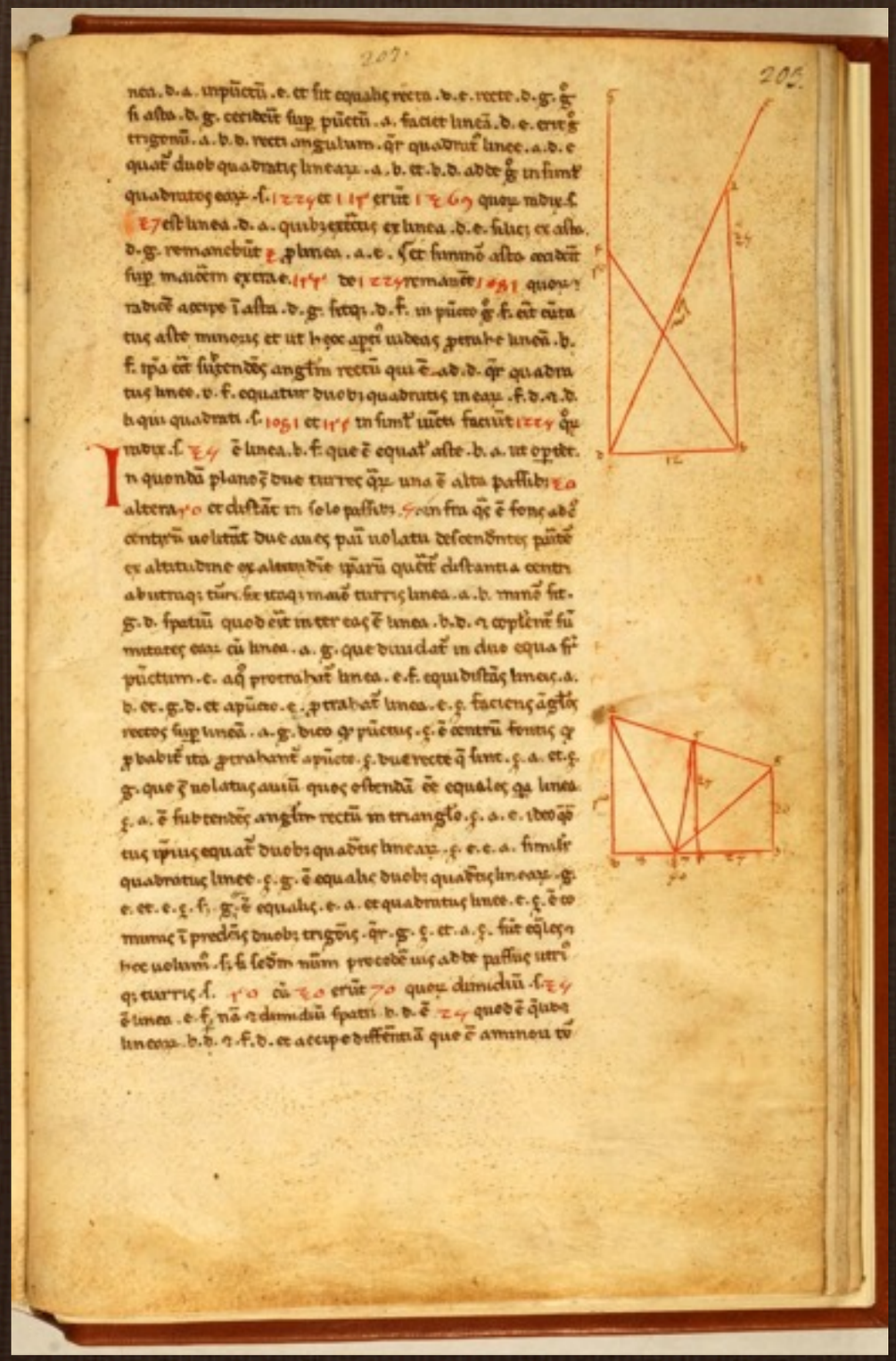


153a



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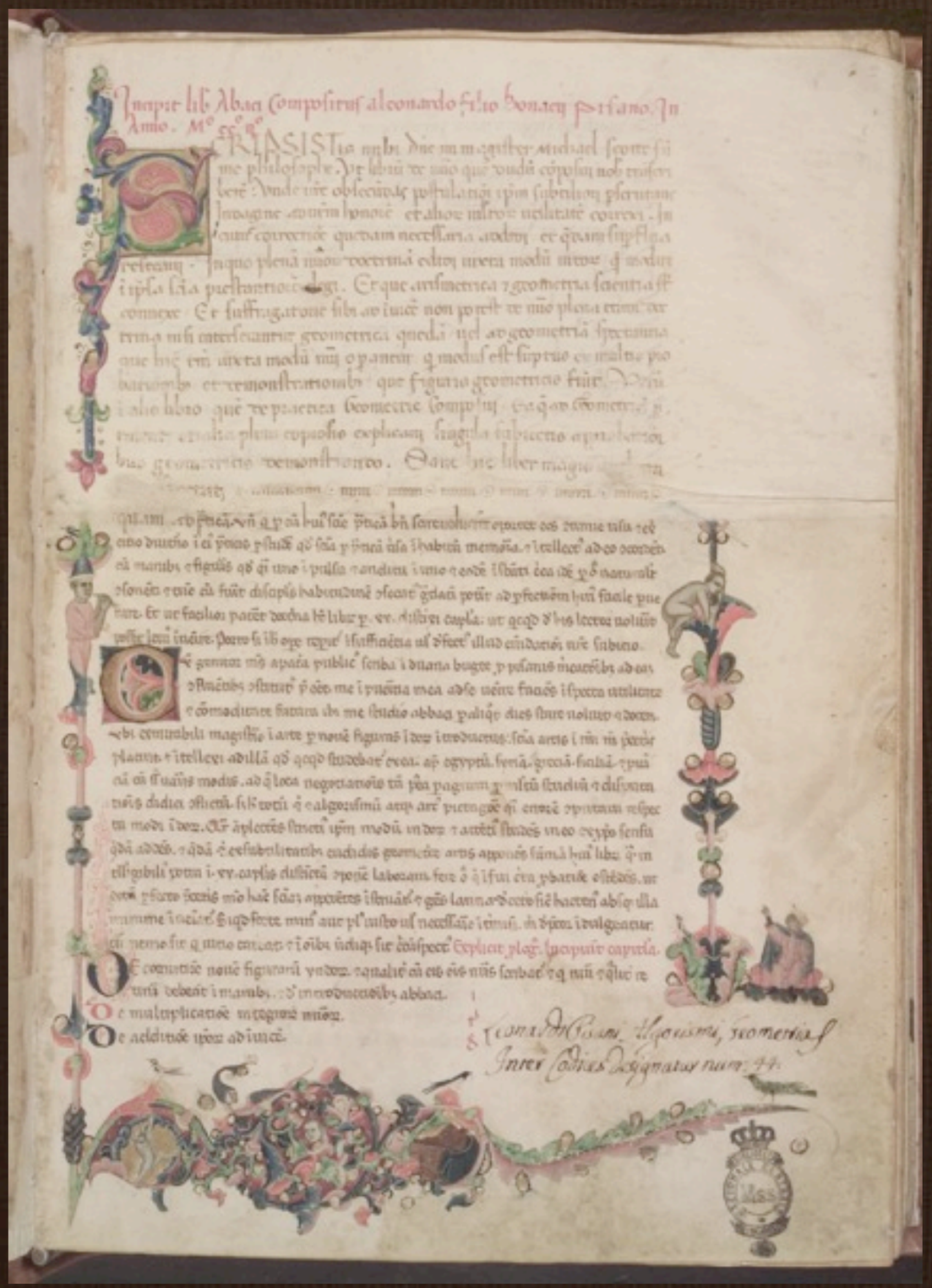

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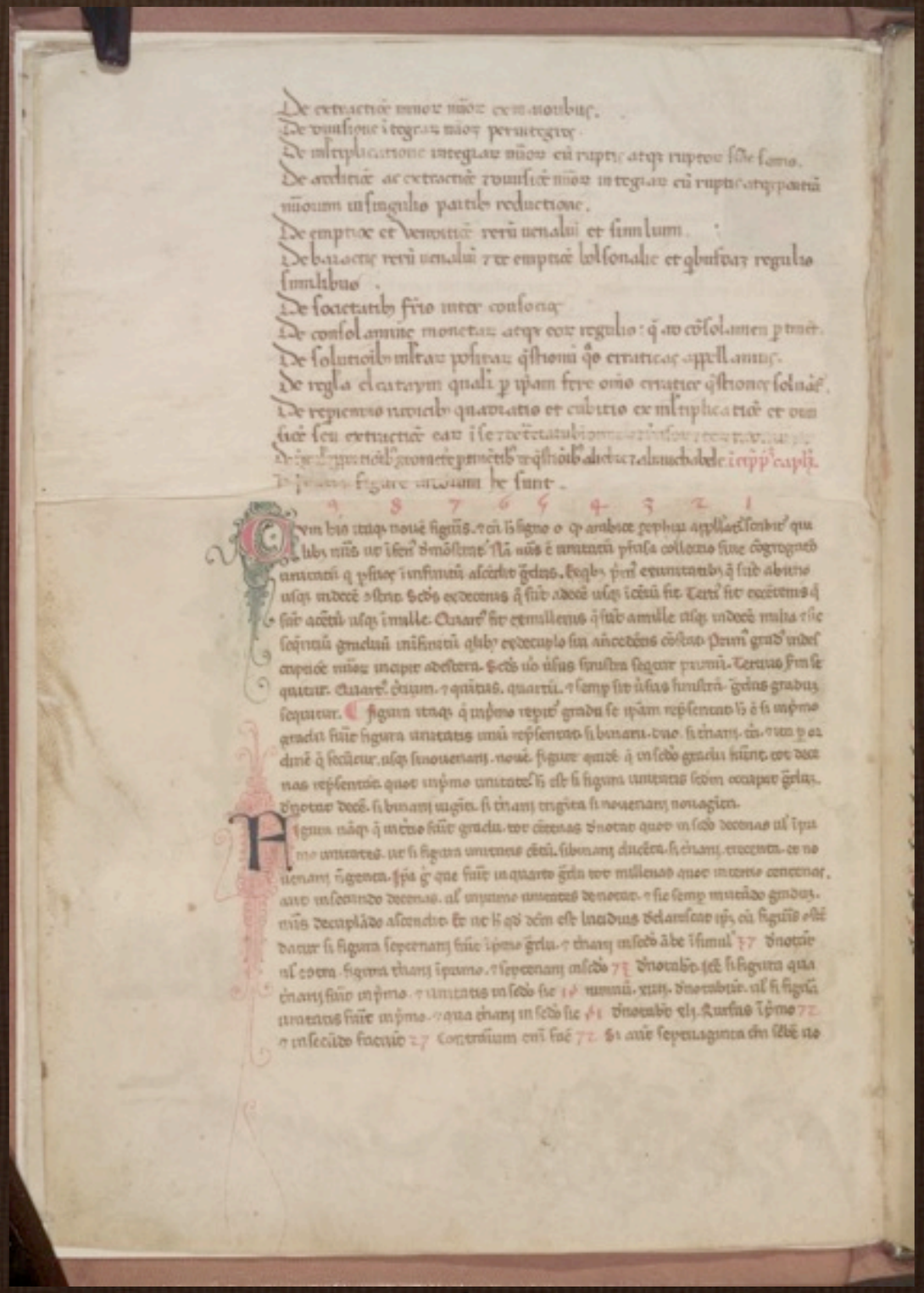

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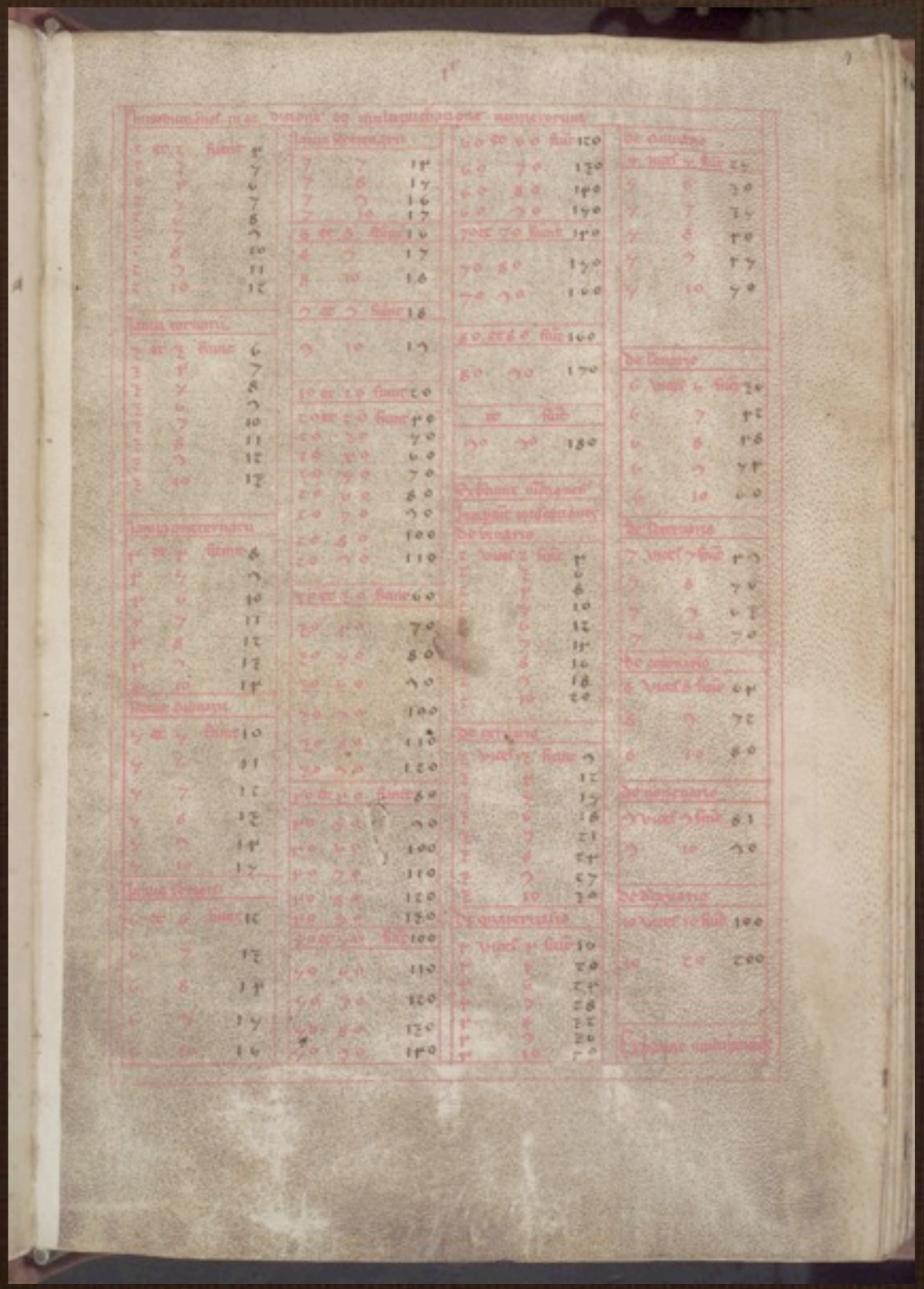

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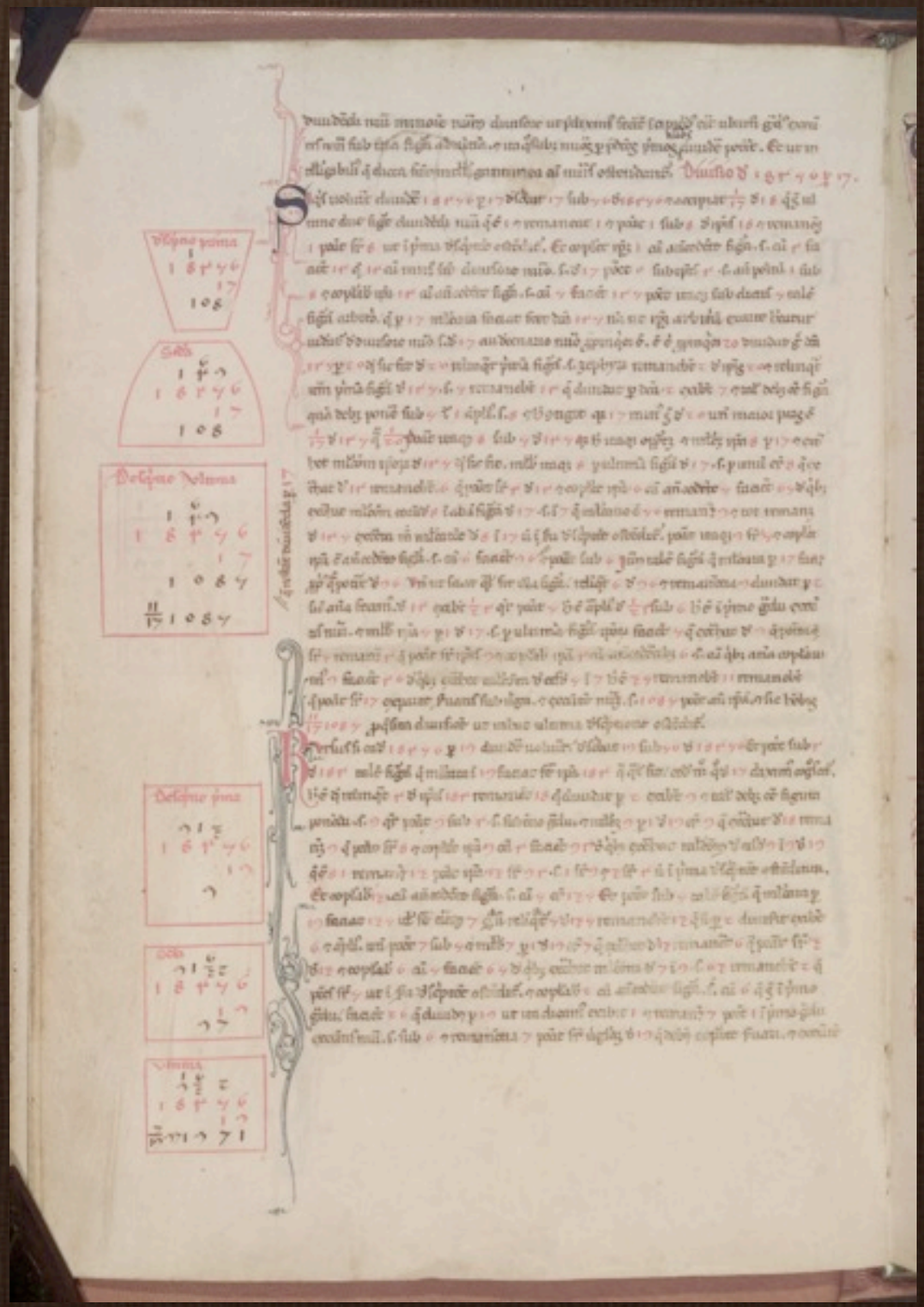

14b

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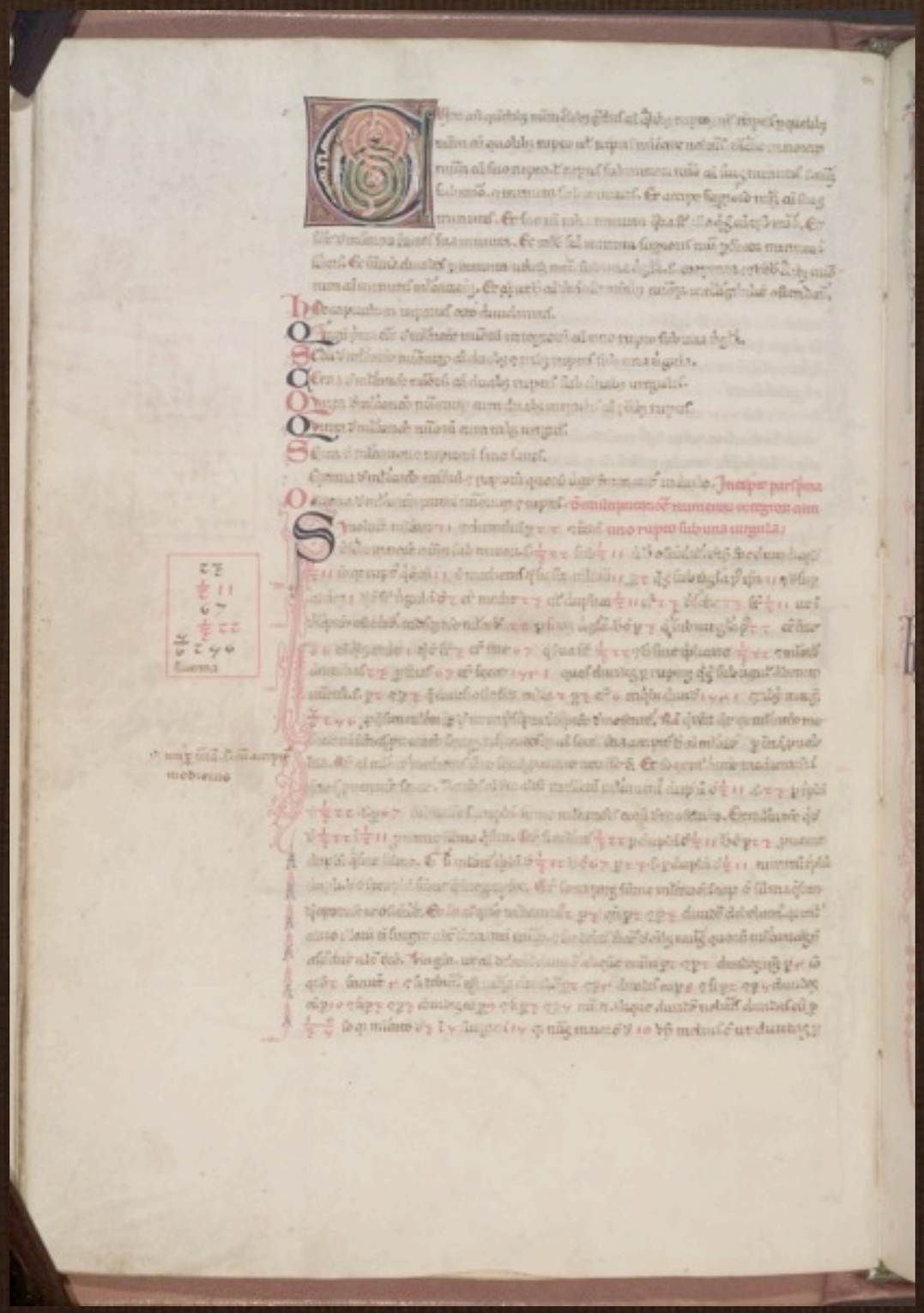

20a

27b

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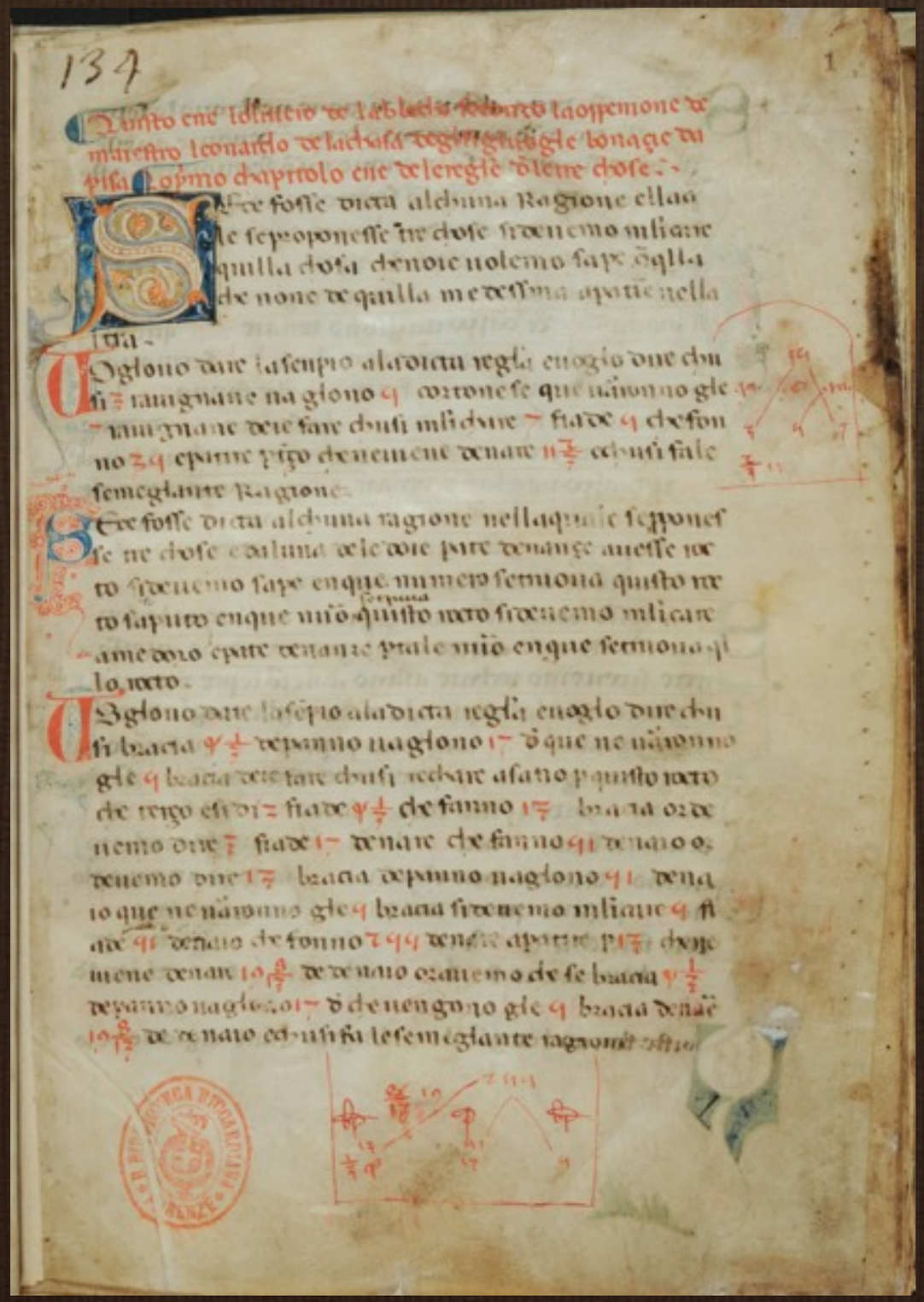

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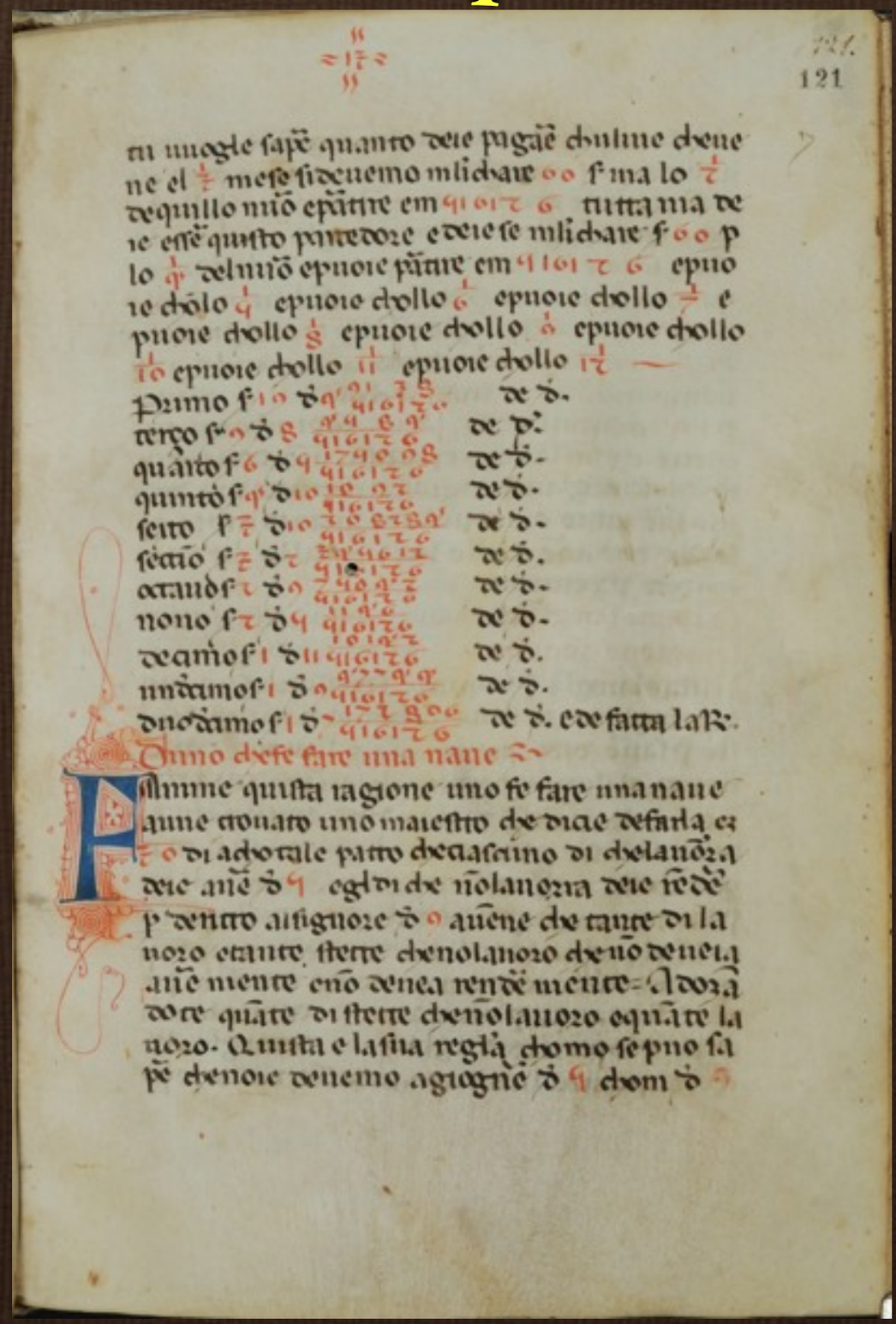

121r

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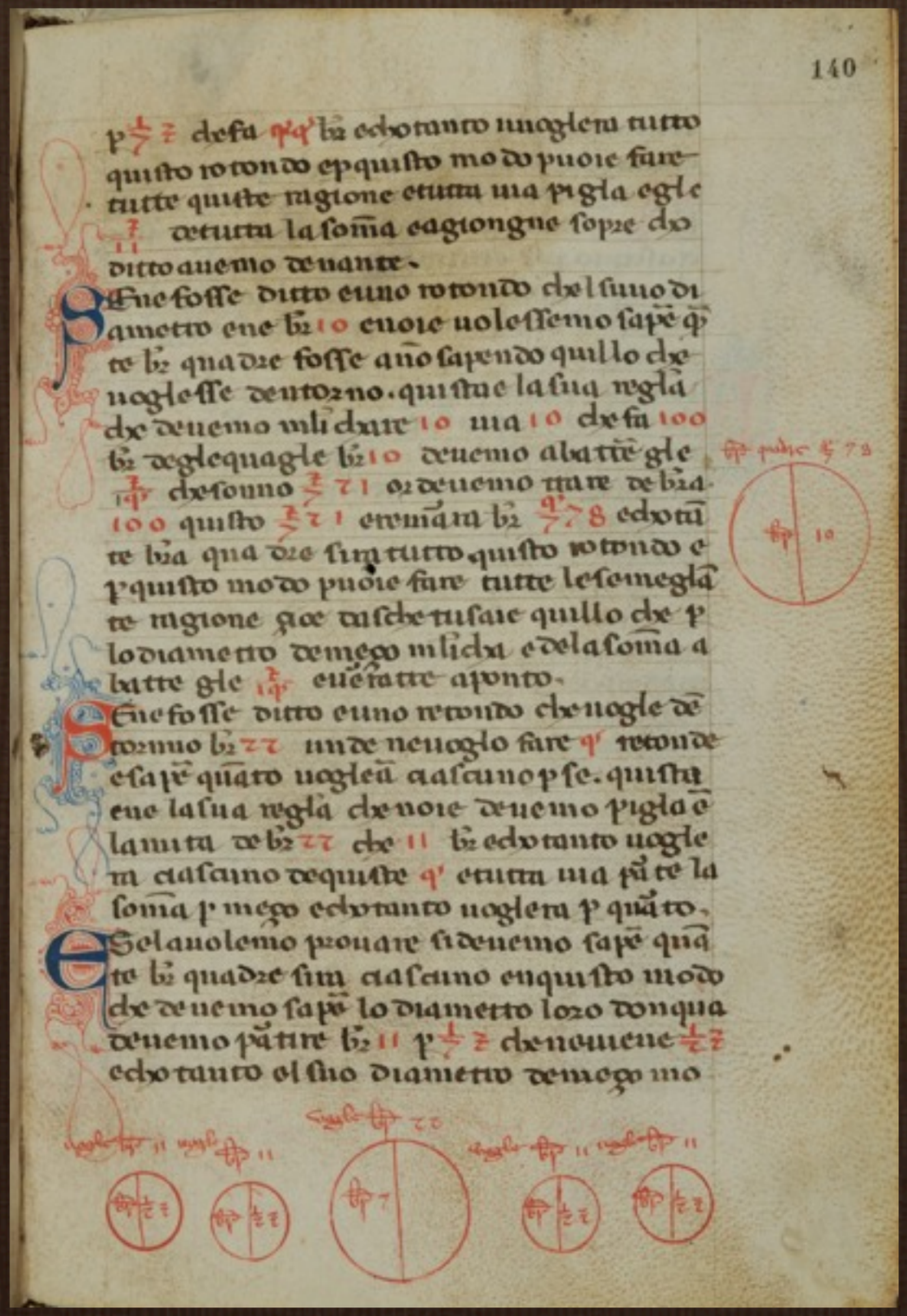


140

p 1/7 z defa q4 b2 echotanto nuogleru tutto quisto rotondo epquisto modo puoie fare tutte quiste ragione etutta uia pigla egle 7/11 detutta lasoma eagiongne sopre dxo ditto auemo denante.

Seuefosse ditto euno rotondo dxel suo diametro ene b2 10 euoie uolessemo sapē qnte b2 quadre fosse ano sapendo quillo dxe nogliesse dentorno. quistae lasua regla dxe deuemo mli dxare 10 uia 10 defa 100 b2 eglequagle b2 10 deuemo abatrē gle 1/14 dxesomo 7/7 21 oz deuemo trare de b2a 100 quisto 7/7 21 eremāa b2 9/7 78 echotā te b2a quadre sia tutto quisto rotondo e pquisto modo puoie fare tutte lesemegla te ragione gioe taschetusare quillo dxe p lodiametro demezo mlidxa edelasoma a batte gle 1/14 euerate apunto.

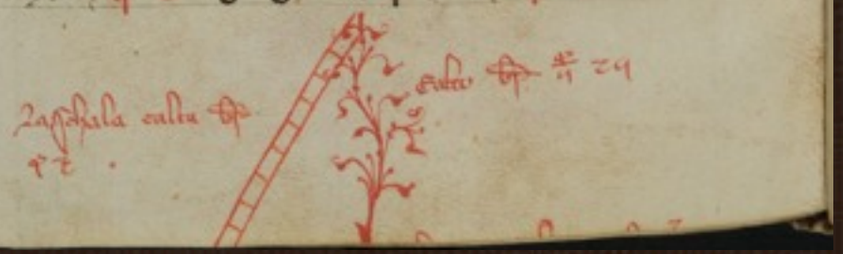
Seuefosse ditto euno rotondo dxe nogle de storno b2 22 unde neuoglo fare q' rotonde esapē quato uogleā aasauno pse. quista eue lasua regla dxe noie deuemo pigla e lamita de b2 22 dxe 11 b2 echotanto uogle m aasauno dequiste q' etutta una pte la soma p mezo echotanto nogleru p quato.

Selauolemo prouare sideuemo sapē qnte b2 quadre sia aasauno enquisto modo dxe deuemo sapē lo diametro lozo donqua deuemo pātire b2 11 p 1/7 z dxenenene 1/22 echotanto el suo diametro demezo mo

Seuefosse ditto euno fiume loquale fiume eb2 1/2 12 edalaltro dxanto delfiume sista uno albore laqnale nō sapemo qnanto sia alto uñ filo nogio fare una scala dxegiongu dala npa delfiume entro ala cima de lalbore adomādare quāto eal tro lalbore equāto sia alta lascala. quista elasua regla dxenoie d uemo piglare el 1/4 delalāgeça delfiume gioe de b2 1/2 12 de b2 1/8 z eglquagle agiogē emsieme dom b2 1/2 12 efam b2 1/8 14 echotā to sia grande lascala epsapē quanto sira alto larboze. sidenemo trare el 1/4 b2 1/2 12 de 1/8 z elremanēte sira 1/8 9 echotanto sira alto larboze.

Selauolemo prouare sideuemo mli dxare lalāgeça delfiume pseme desmo edare 1/2 12 uia 1/2 12 defa b2 1/4 146 modeuemo mli dxare lonzo delarboze edare 1/8 9 una 1/8 9 defa 17/9 6 eglquagle agiongne emsieme dxo b2 1/4 146 te efara b2 2/4 294 deglquagle deuemo trouare lasua radige de 1/8 14 domo uole essere echusi fa le semeglante ragioē apunto.

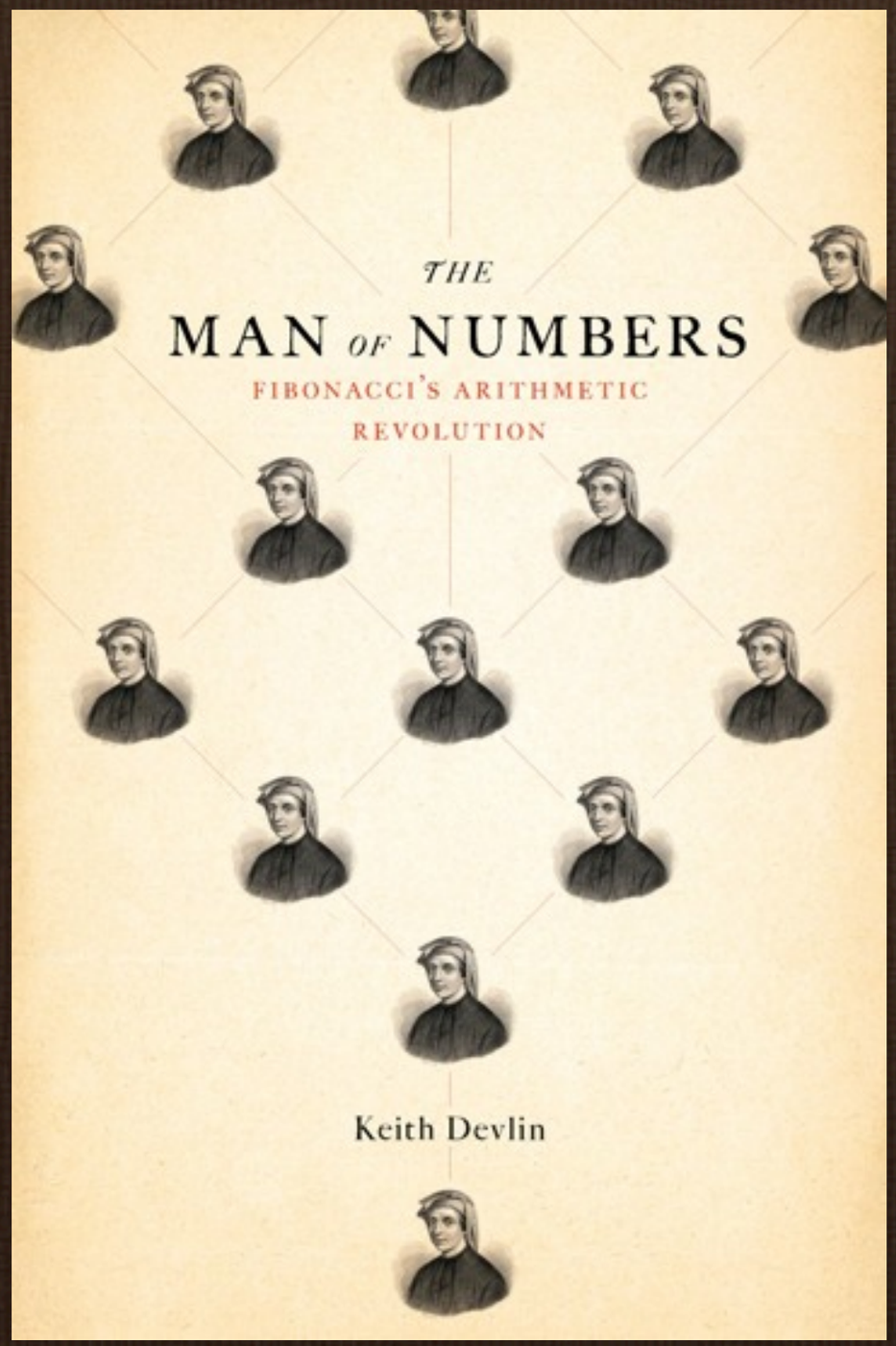
Seuefosse ditto de uno arbora alto b2 9/4 24 euno fiume eapiede delarboze edio nogio po nēe una scala dalacima delalboze ala proma delfiume adomādote quāto sira largo elfi ume equāto sira larga lascala apunto. qui sara elasua regla gioe dxenoio deuemo pigla re el 1/2 delalāgeça delalboze gioe de b2 9/4 24 de b2 3/4 8 egiogne sopra ab2 9/4 24 efara b2



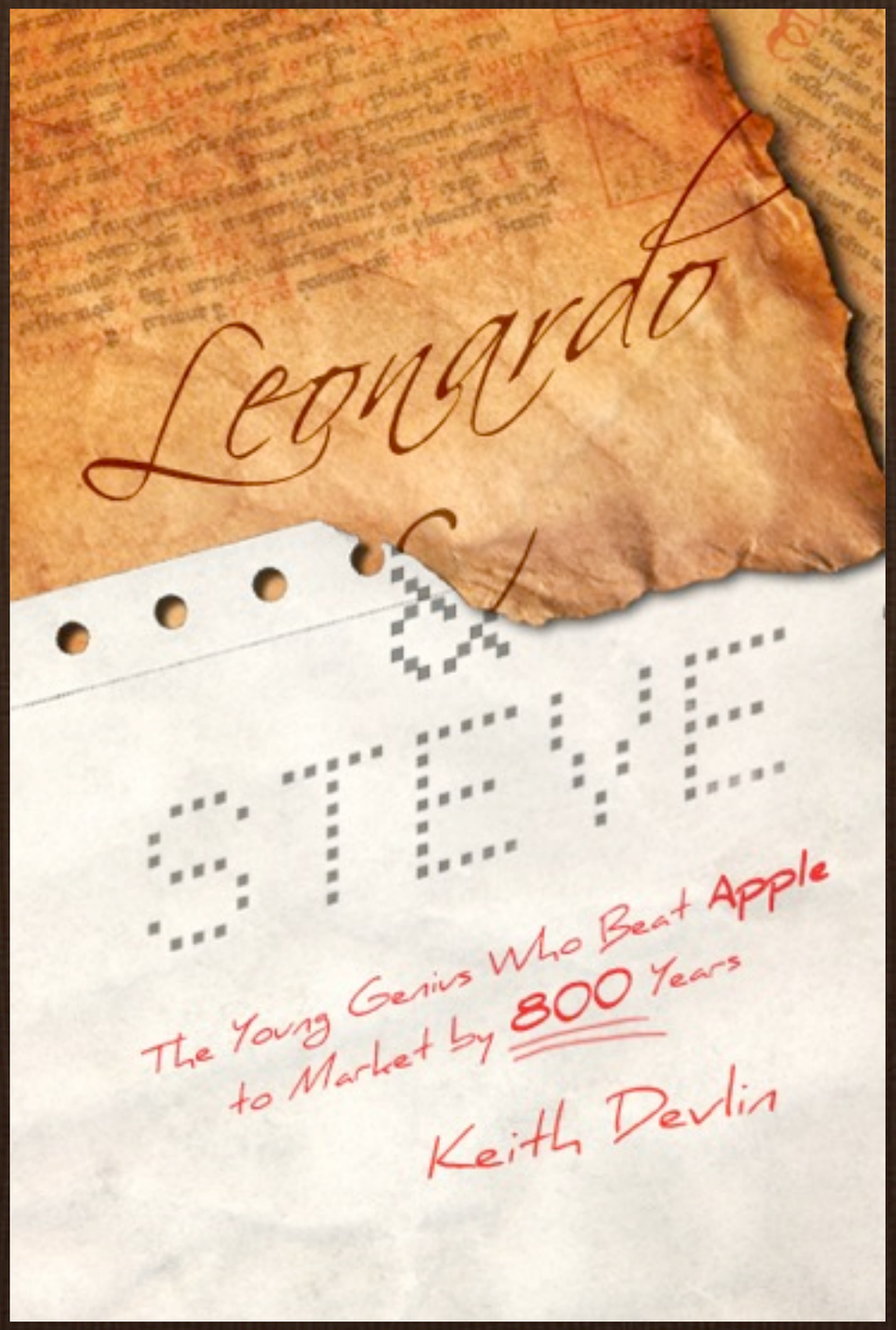
140r

153v

My Leonardo books



New York: Walker & Co.



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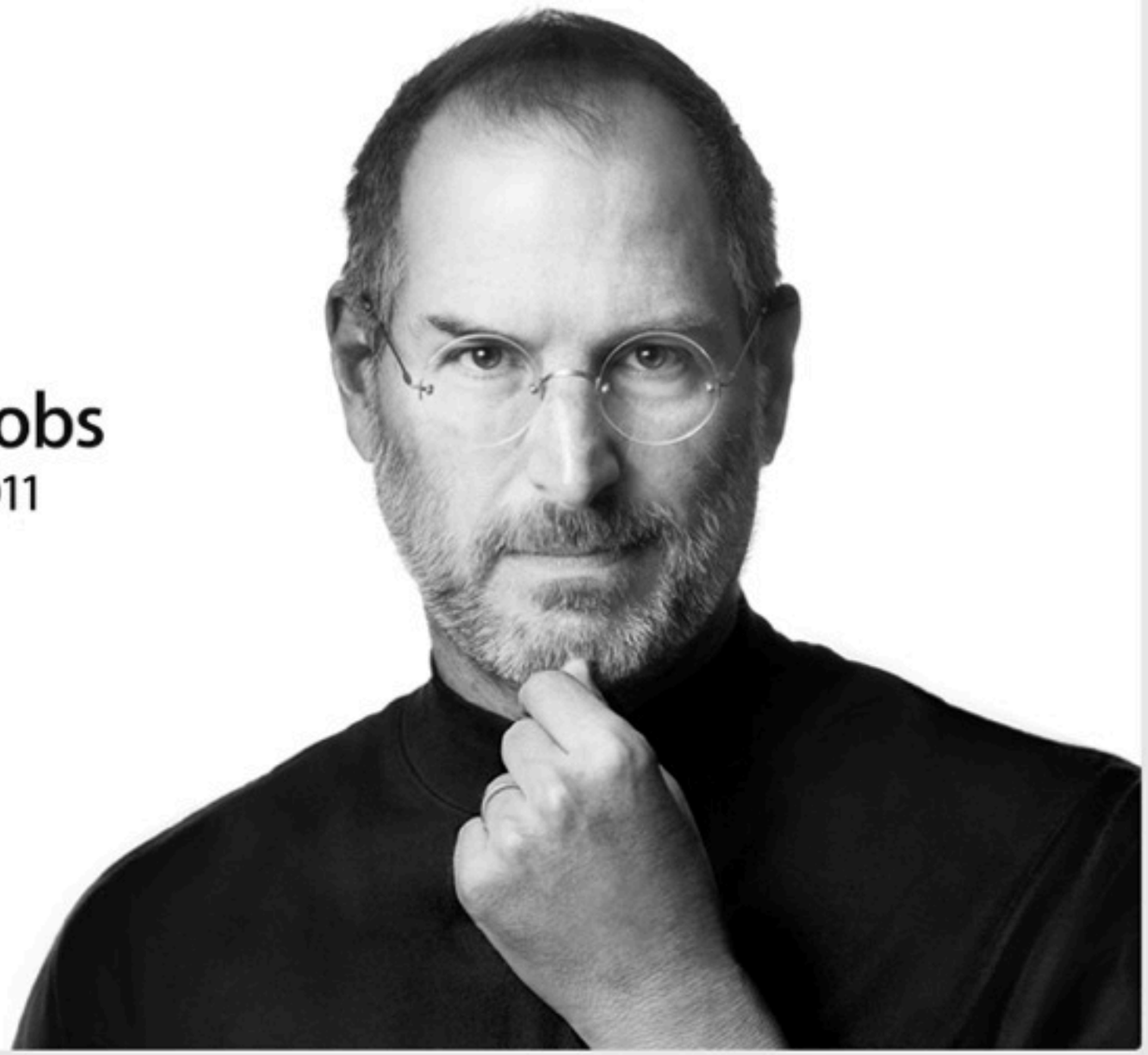

Steve Jobs

1955-2011