Isidore of Seville (560-636 AD, Saint Isidore in 1598)

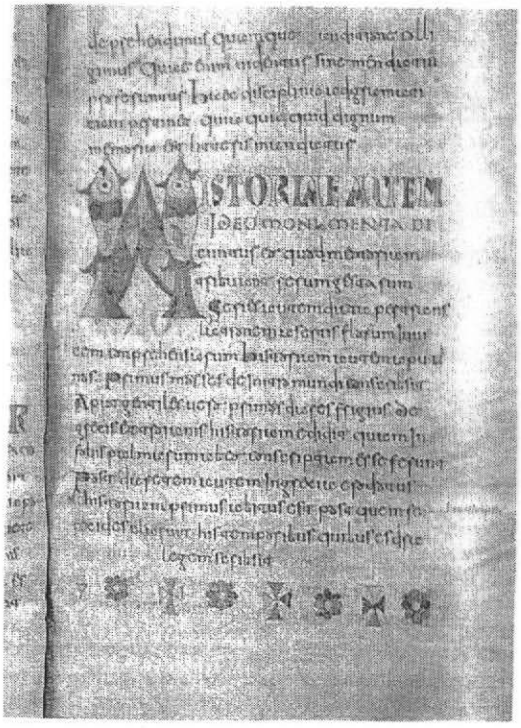
"le dernier savant du monde ancien" ("the last scholar of the ancient world").

St. Isidore, depicted by Murillo

Patronage *(only proposed, but quite well embraced)* computers, the internet; students (:)

Isadore was the first Christian writer to attempt the task of compiling an Encyclopedia of the knowledge of the times, called the *Etymologiae* (taking its title from the method he used in the transcription of his era's knowledge).

Until the twelfth century brought translations from Arabic sources, Isidore transmitted what western Europeans remembered of the works of Aristotle and other Greeks, although he understood only a limited amount of Greek. The *Etymologiae* was much copied, particularly into medieval bestiaries.



This text was what educated men studied for the Quadrivium.

Pope Sylvester II (Gerbert d'Aurillac)

(946-1003 AD

He introduced Arabic knowledge of arithmetic, mathematics, and astronomy to Europe, reintroducing the abacus and armillary sphere which had been lost to Europe since the end of the Greco-Roman era.

In 967, abbot Borrell II of Barcelona (947–992), visited the monastery, and the abbot asked to take Gerbert with him so that the lad could study mathematics in Spain and acquire there some knowledge of Arabic learning, but probably only through Latin translations. Gerbert learned from the Arab teachers in Spain subjects that no one in the rest of Europe had even heard of, the most important being the Arabic numbers.

First appearance in West of 0-9
(0 represented by a blank space)

Quadrivium:

Gerbert, as a scientist, was said to be far ahead of his time. Gerbert wrote a series of works dealing with matters of the quadrivium (arithmetic, geometry, astronomy, music). Gerbert's reintroduction of the emphasis on these liberal arts in Europe was inspired by the educational institution of Cordoba in Islamic Spain.

In Rheims, he constructed a hydraulic-powered organ with brass pipes that excelled all previously known instruments, where the air had to be pumped manually.

In a letter of 984, Gerbert asks Lupitus of Barcelona for a book on astrology and astronomy, two terms which historian S. Jim Tester states were used synonymously by Gerbert.

Gerbert may have been the author of a description of the astrolabe that was edited by Hermannus Contractus some 50 years later.

As Sylvester II he wrote a dogmatic treatise, *De corpore et sanguine Domini*.

Also introduced counting board (aka, an abacus)

Abraham bar Ḥiyya ha-Nasi

(1070-1136 AD)

(Hebrew: **אברהם בר חייא הנשיא** *Abraham son of [Rabbi] Hiyya "the Prince"*)

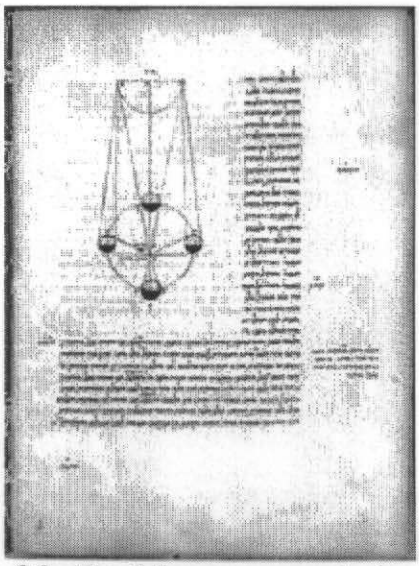
Born and lived in Barcelona, he was a Spanish Jewish mathematician, astronomer and philosopher, also known as **Savasorda** (from the Arabic **صاحب الشرطة** *Sâhib ash-Shurta* "Chief of the Guard"). He lived in Barcelona and was probably an officer in the royal court of Spain.

Bar Hiyya wrote all his works in Hebrew, not in Judaeo-Arabic of the earlier Jewish scientific literature, which made him a pioneer in the use of the Hebrew language for scientific purposes. He also cooperated with Plato of Tivoli in the translation of scientific works from Arabic into Latin.

The Foundations of Understanding and the Tower of Faith,
An encyclopedic work, which is said to treat of arithmetic, geometry, optics, astronomy, and music. Unfortunately only a few short fragments of this work have been preserved

Took over the Islamic tradition of giving proofs for algebraic procedures.
"If from the area of a square one subtracts the sum of the sides and there remains 21, what is the length of the (equal) sides? $x^2-4x=21$ (solve by completing the square & justify by appeal to Euclid II.6).
Al Kwarizmi's methods not present.

Treatise on Mensuration and Calculation ("Treatise on Geometry"),
This was translated in 1116 by Plato of Tivoli, under the title *Liber Embadorum ("Book of Areas"*



An astronomy diagram from *Form of the Earth"*, an astronomical work on the formation of the heavens and the earth, which was to have been followed by a second part on the course of the stars

bar Hiyya's Proof for Area of Circle $= \frac{D \cdot C}{4} (= \pi R^2)$

in Hebrew text, not translated by Plato into Latin.

$A = \int_{r=0}^{R} (2\pi r)\, dr = \pi r^2$

Concentric circles of indivisible threads unfold into a triangle

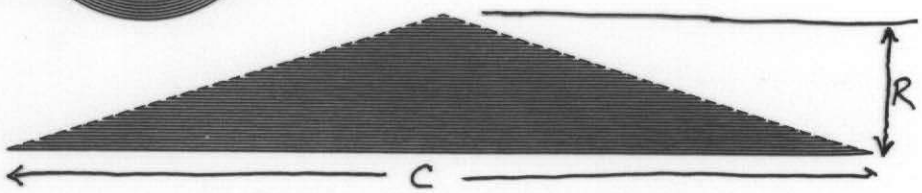
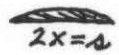


FIGURE 8.1 Circle unfolded into a triangle

To measure area of  $2x = s$

$\frac{x}{r} = \sin(\theta)$ so $\theta = \arcsin\left(\frac{x}{r}\right)$

Length of .... (height of Δ) is

$h = \sqrt{r^2 - x^2}$

Area of triangle: $\frac{1}{2}sh$

Area of sector: $r^2(2\theta)$

His β is $\frac{88}{\pi} \approx 28$ times our θ.

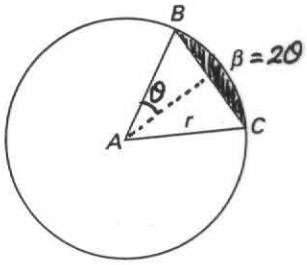


FIGURE 8.2 Area of segment $B\beta C$ = area of sector $AB\beta C$ − area of triangle ABC; area of sector = $r\beta/2$

Partes Cordatum	Arcus		
	Partes	Min.	Sec.
1	1	0	2
2	2	0	8
3	3	0	26
4	4	0	55
5	5	1	44
6	6	2	54
7	7	4	42
8	8	7	11
9	9	9	56
10	10	13	42
11	11	18	54
12	12	24	38
13	13	31	9
14	14	40	0
15	15	50	10
16	17	2	16
17	18	16	36
18	19	33	27
19	20	53	26
20	22	17	10
21	23	45	6
22	25	19	24
23	27	0	0
24	28	49	56
25	31	26	37
26	33	20	52
27	36	27	32
28	44	0	0

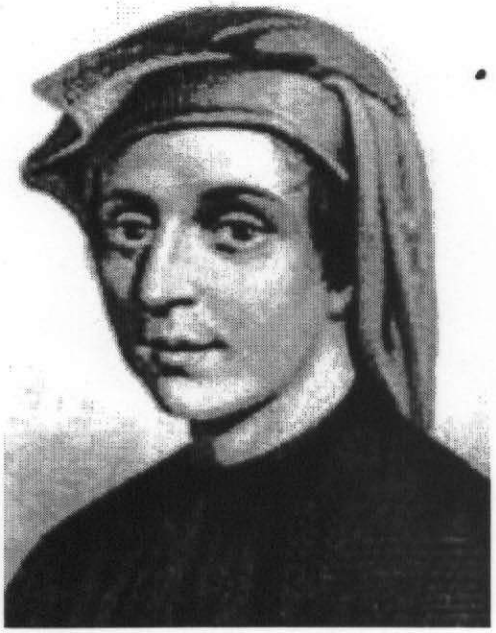
If $\pi = \frac{22}{7}$ and $r = 14$ then $C = 44$

← semicircle $r = 14$

FIGURE 8.3 Arcchord table of Abraham bar Ḥiyya

Fibonacci or Leonardo of Pisa (c. 1170 – c. 1250),

also known as **Leonardo Pisano, Leonardo Bonacci, Leonardo Fibonacci**, ...His father Guglielmo was nicknamed Bonaccio ("good natured" or "simple"). Leonardo was posthumously given the nickname Fibonacci (derived from *filius Bonacci*, meaning son of Bonaccio).



- Showed how to calculate π (or C/D) by 96-gon
  average circumscribed & inscribed to get $1440:458\frac{1}{3}$
  $1440:458\frac{1}{5}$ $1440:458\frac{5}{8}$ $22:7$
- Lion eats sheep in 4 hours
  Leopard " " 5 "
  Bear " " 6 "
  } How long for all three together?
- Find $x \equiv 1 \bmod 2$
  $\equiv 2 \bmod 3$
  $\equiv 3 \bmod 4$
  $\equiv 4 \bmod 5$
  $\equiv 5 \bmod 6$
  $\equiv 6 \bmod 7$
  $\equiv -1 \bmod 60$
- Four Men. A, B, C have 27 denarii together
  B, C, D " 31 " "
  A, C, D " 34 " "
  A, B, D " 37 " "

Fibonacci is best known to the modern world for:

- The spreading of the Hindu-Arabic numeral system in Europe, primarily through the publication in the early 13th century of his *Book of Calculation*, the *Liber Abaci*.
- A number sequence named after him known as the Fibonacci numbers, which he did not discover but used as an example in the *Liber Abaci*.
- The book showed the practical importance of the new numeral system, by applying it to commercial bookkeeping, conversion of weights and measures, the calculation of interest, money-changing, and other applications. The book was well received throughout educated Europe and had a profound impact on European thought.
- Many of the problems are taken from al Kwarizmi, Abu Kamil and (via arabic translation) problems from Egypt, India and China. (Includes 6 basic types of quadratic equation.)

His father directed a trading post in Bugia, a port east of Algiers in the Almohad sultanate in North Africa (now Bejaia, Algeria). As a young boy, Leonardo traveled there to help him. This is where he learned about the Hindu-Arabic numeral system.

Recognizing that arithmetic with Hindu-Arabic numerals is simpler and more efficient than with Roman numerals, Fibonacci traveled throughout the Mediterranean world to study under the leading Arab mathematicians of the time. Leonardo returned from his travels around 1200. In 1202, at age 32, he published what he had learned in *Liber Abaci*

Fibonacci's chord table based on radius of 21 (not 28), ½ circumference = 66 rods

1 rod = 6 feet, 1 foot = 18 unciae, 1 uncia = 20 points, 1 point ≈ 1 mm.