

Pious Representation

the Medieval Period

before 800AD

struggling period following

split of Roman Empire into E and W, 300

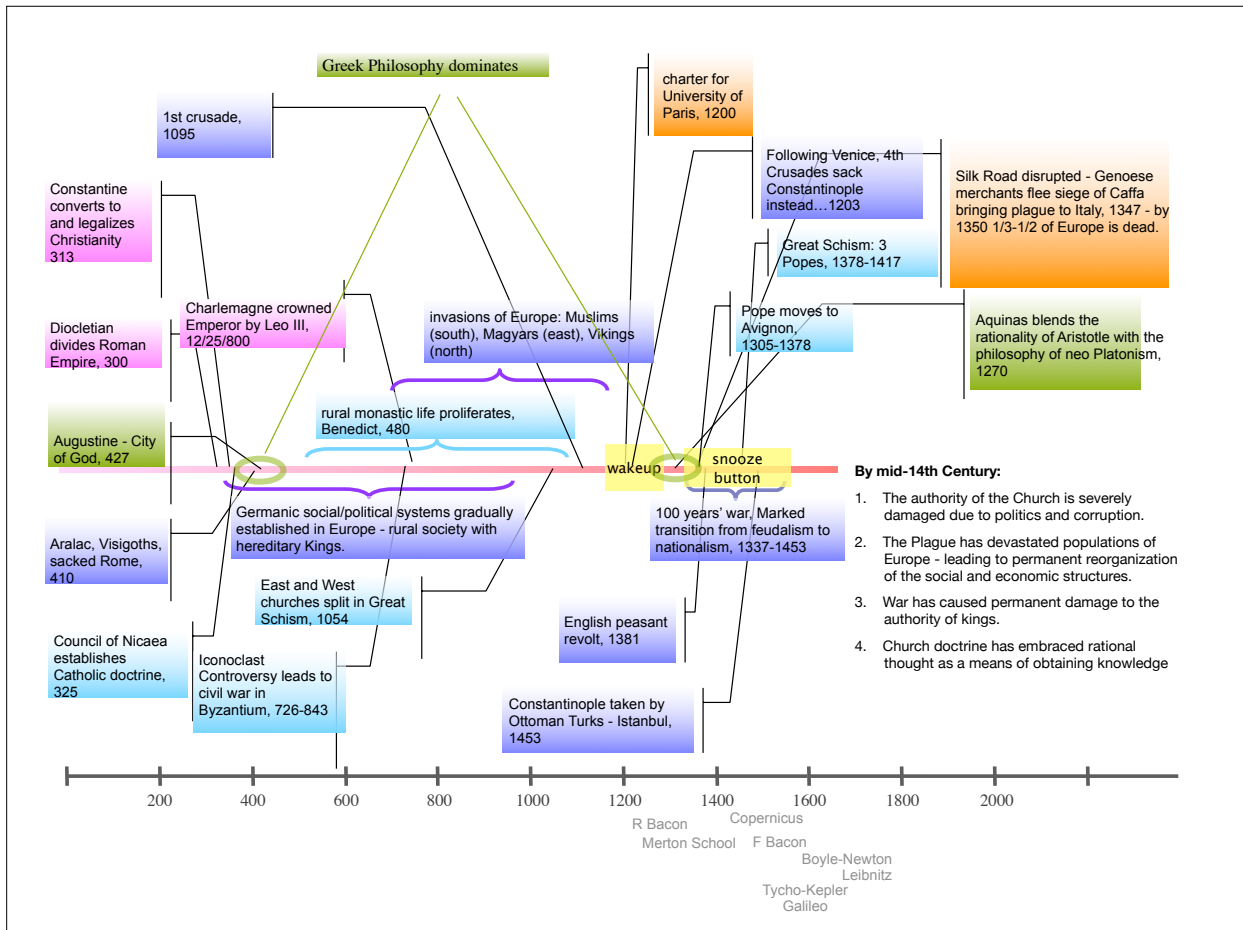
sack of Rome by Visigoths, 410

Charlemagne: First Holy Roman Emperor, 800

the middle ages...

on one slide.

no charge.



Greek Learning?

some Roman commentary

some Greek translations

the first part of Timeaus

some of Aristotle's logic...but not widely

the center

of all learning and art

Church

all aspects of life:

afterlife important, not real life

what's true?

eternity

otherwise, rural

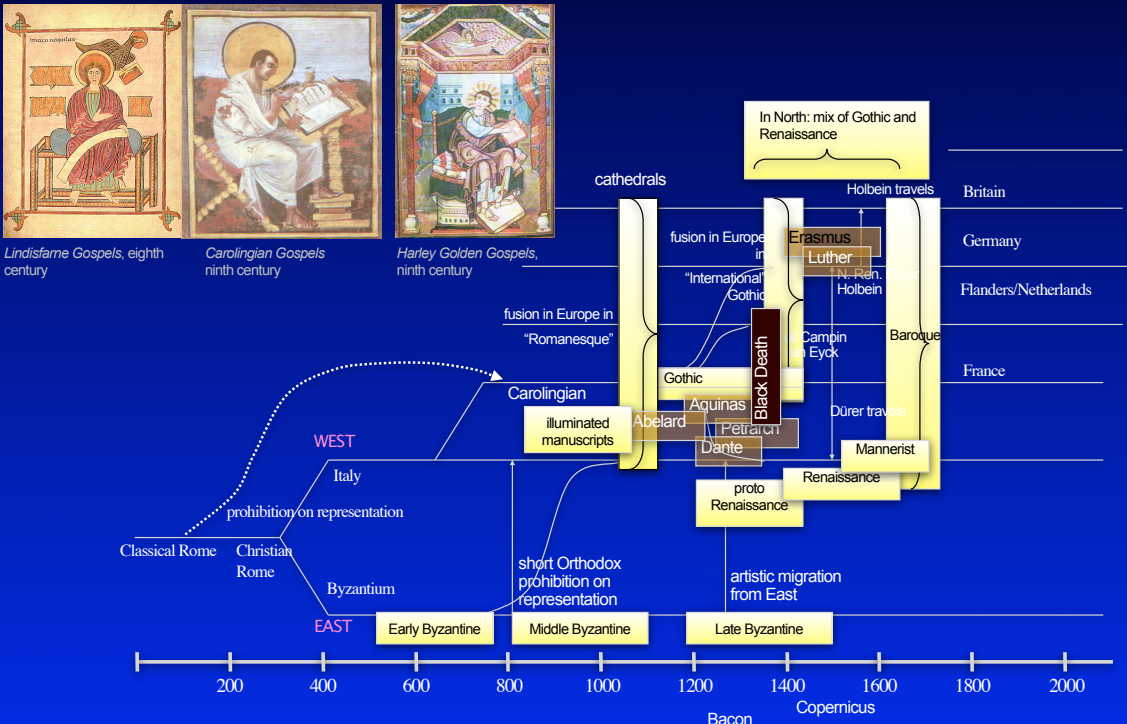
dark forests, superstition, ignorance

art?

illustrated manuscripts in monasteries
architecture

all of european art

on one slide
no charge.

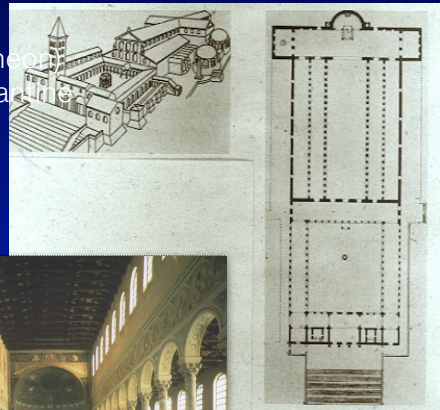


Notice that the older illustration is abstract - that's no structure that St. John is sitting on
 The Carolingian Gospel illustration could have come from a Pompeian wall and the Harley is a fully articulated body...

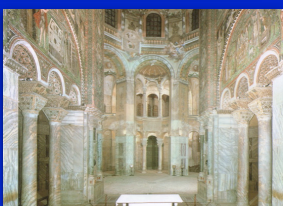
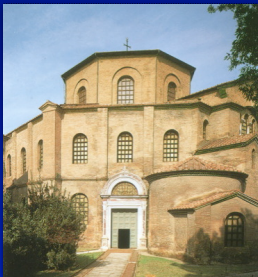
two Roman styles were perpetuated

an old circular, domed, central layout (like the Pantheon) and the elongated basilica format applied by Constantine

originally a Roman civic architectural form
 the original St. Peter's (Constantine)
 St. Mark's, Venice



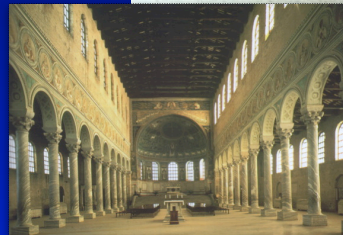
Original St Peter's



S. Vitale, Ravenna, ca 526, Justinian



Hagia Sophia, Emperor Justinian, 532

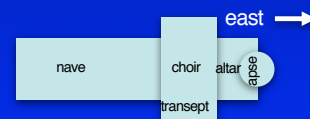


S. Apollinare, Ravenna, ca 533

worship



Basilica

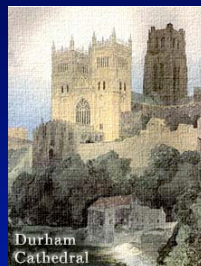


“pilgrimage churches”

handful during medieval times
*housed relics which attracted pilgrims
along well-known routes*

constructed similarly along the “Latin
Cross” plan
basilica format

huge naves with flanking aisles



Durham, England



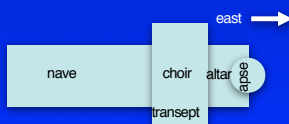
Pisa, Italy

Romanesque

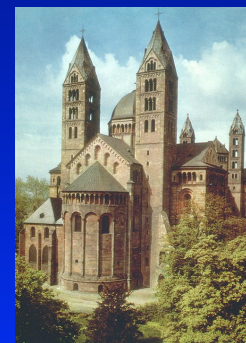
*barrel vault - reduced the fire hazard
associated with wooden roofs, but
required thick, solid walls*

only light from very top - DARK

A building boom all over Europe



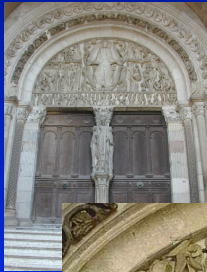
Saint-Sernin, Toulouse, France, ~1070



Speyer, Germany

Architectural decoration: return of monumental sculpture

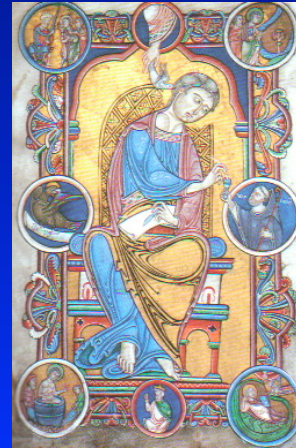
often telling a story usually associated intimately with the architecture
sprang up all over Europe nearly at the same time
often complex, agitated and decorative
more independent of the surface than just relief...



tympanum, Cathedral Saint-Lazare, Autun ~1120-35



North jamb, center portal, St-Gilles-du-Gard, ~1180



Saint John the Evangelist, from Gospel Book of Abbot Wedricus, 1147

While western Christian art transformed the Classical style

In the east, it remained largely in tact - with the Greek and Oriental influences dominating the Roman

this heritage presumably fixed the likeness and the style

the introduction of the Icon became an object of worship, on par with the relics

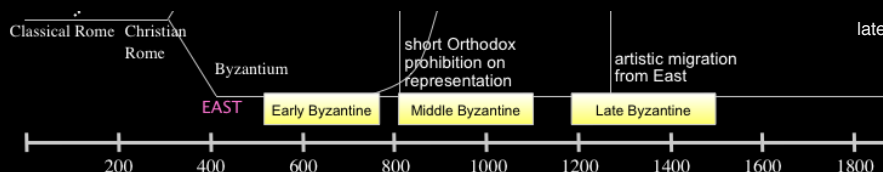


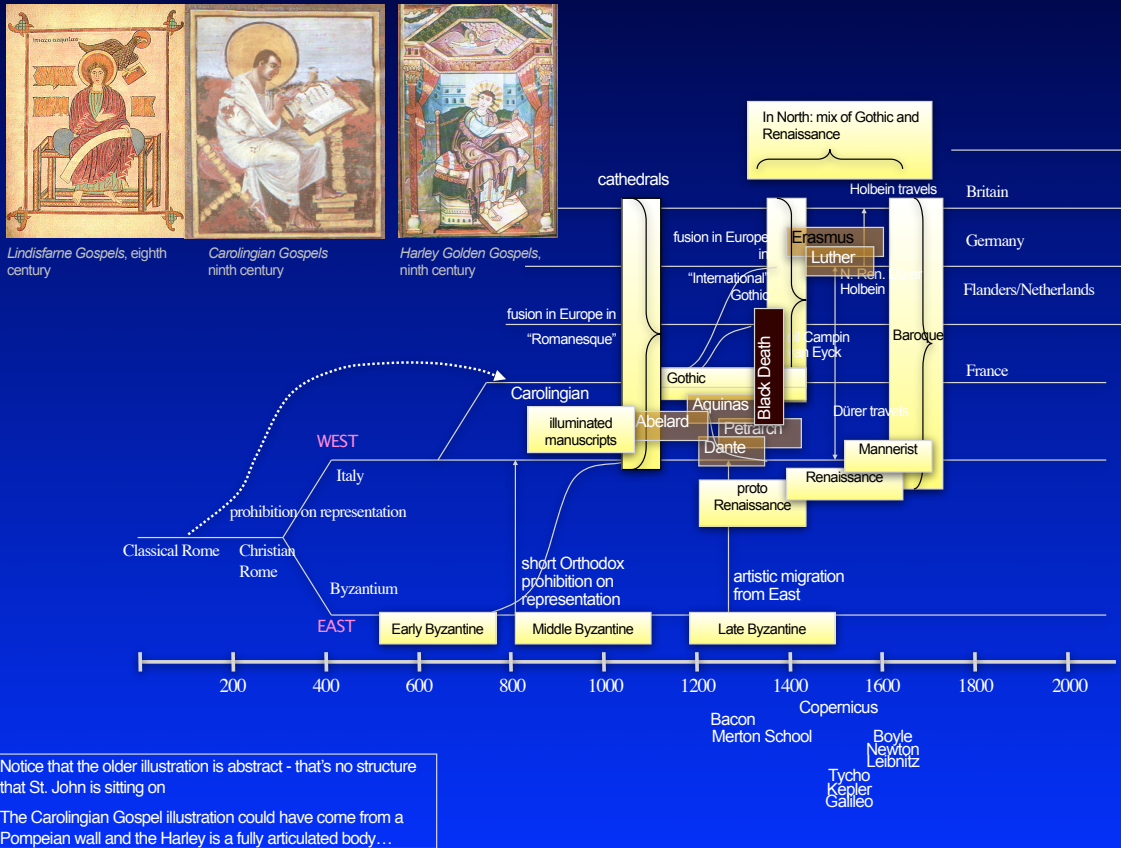
from S. Vitale, Theodosa and her court, flanked on an opposite wall of Justinian and his court.



Virgin and Child Enthroned between Saints Theodore and George and Angels,

late 6th century - one of the oldest and first icons of Mary





Liturgical purposes dominated

The icon became a set pattern with rules: "iconography"

size of figures, according to religious hierarchy, always a gold background, poses fixed, Peter: always rounded beard; John the Baptist, scraggly beard; Paul, always bald; Christ, blue and gold before, purple and gold after the resurrection; Virgin, blue and purple; Peter, gold and beige

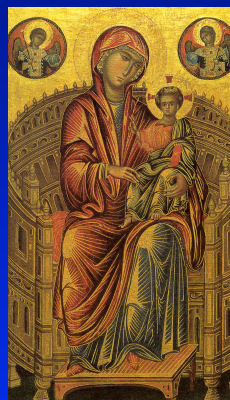
after crusades, west and east influence each other



Virgin and Child Enthroned, 843, Hagia Sophia



Mother of God and Protectress of the Church, Church of Our Lady of the Pharos, Constantinople, 11C



Madonna and Child on a Curved Throne, 1280



Christ as Ruler of the Universe, the Virgin and Child, and saints, 1190, cathedral of Monreale, Sicily

GOthic

had a beginning

1140

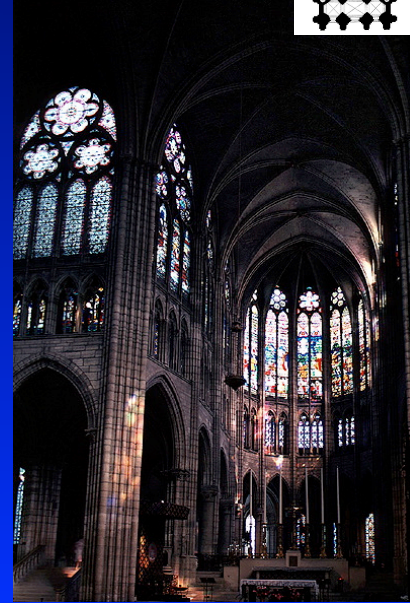
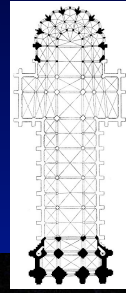
associated with

LIGHT

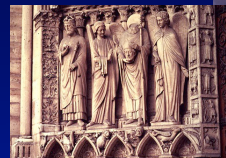
A style with a definite beginning

Abbot Suger, Benedictine monk and politician, determined to make the Royal Abbey at Saint-Denis (~ca 8th century)

played up historical lineage assumed by French royalty to Charlemagne, targeted Saint-Denis for attention - Both Pepin and Charlemagne had been consecrated there...



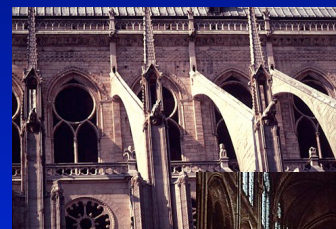
Chartres Cathedral, 1194



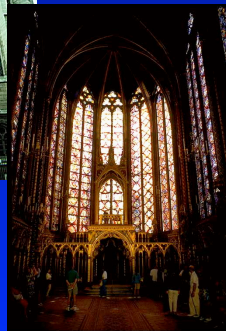
Sainte-Chapelle, Paris, 1243



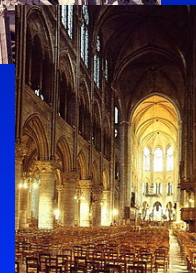
Canterbury Cathedral, ca 1070



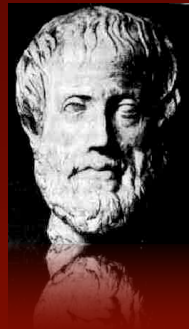
Notre Dame Cathedral, ca 1163



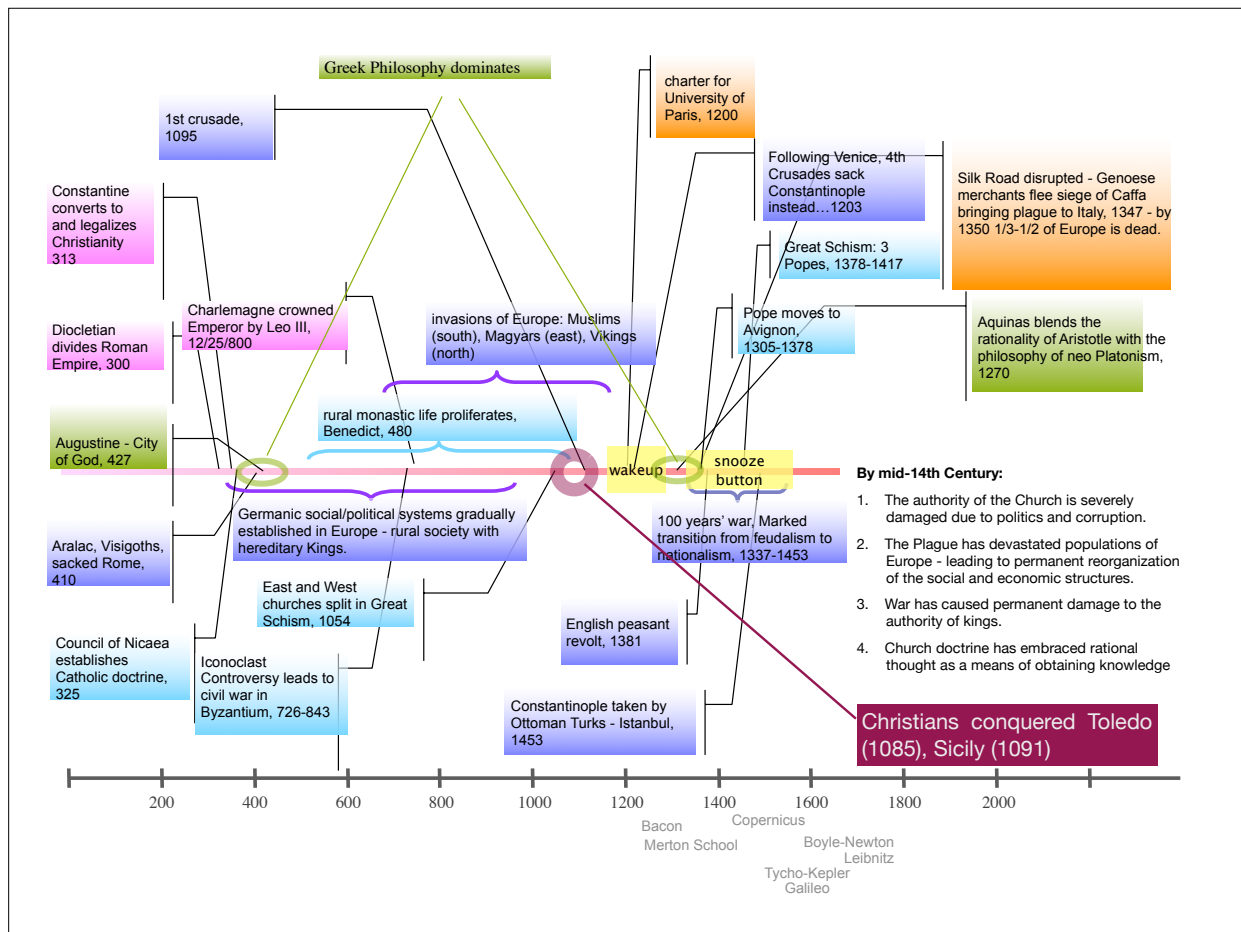
Milan Cathedral, 1386



ahead of our story



the sequel



after 1085, 1091

Toledo (& Normans in Sicily)

ALL of:

Aristotle, Galen, Euclid,
Plato, Archimedes, Ptolemy

the Arab Commentators: Avicenna & Averroes

Jewish commentator: Maimonides

everything we know, they found all at once

by 1135:

Physics: 371 manuscripts from Greek; 134 from Arabic

On the Heavens: 117 from 150 from 173

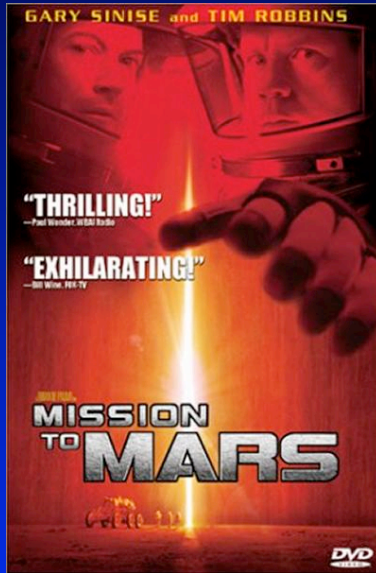
On Generation and Corruption: 308 & 48

2000 separate manuscripts extant now

Arabic->Hebrew->Latin

Greek->Syriac->Arabic->Spanish->Latin

etc



bad physics, but got me thinking



Logic

Another **FIRST** from Mr. Aristotle

officially

study of propositions



“

...**every** proof and every deductive inference **must**
come about through the three figures that we have
described...

Aristotle

He claims to have a recipe by which:

“...certain things being stated, something other than what is stated follows of necessity from their being so.. I mean by the last phrase that they produce the consequence, and by this, that no further term is required from without to make the consequence necessary.

Aristotle, Prior Analytics

necessity

make certain statements and
you can't avoid a conclusion
a tool for knowledge?

Aristotle's guarantee

the key to science

(for A)

the establishment of definitions

arrange observation sentences mentally

“deduce” new knowledge from old (?)

only 3 statements

1. Singular statements: Socrates is a man.
2. Universal statements: Every man is mortal
3. Particular statements: Some men are mortal.

4 kinds of propositions

A ffirmio: All men are mortal

aff I rmo: Some men are mortal

n E go: No men are mortal

neg O: Some men are not mortal

always about the swans



All Swans are white.



No Swans are white.

...can both be false.

...But, they cannot both be true: contrary statements

so boring about the swans



Some Swans are white.



Some Swans are not white.

...can both be true.

...they cannot both be false: sub-contrary statements

alright already with
the swans



Some Swans are white.

...can both be true.

...can both be false



Some Swans are black.

all it takes to
falsify “all”
propositions?

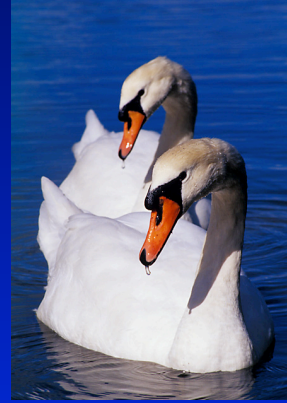
one contrary instance

vaguely “scientific”

Aflack!



All Swans are white.

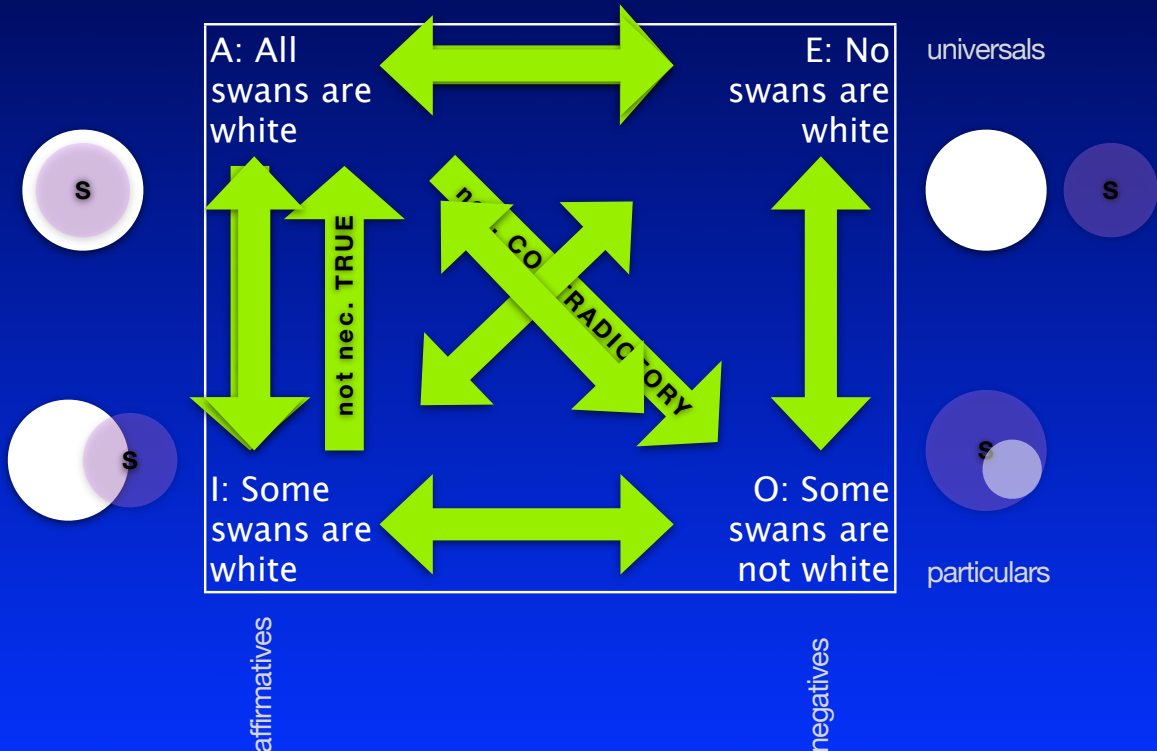


Some Swans are white.

If all swans are white then it MUST FOLLOW some swans are white.

already inside of "all" swans is "some" swans

Square of Opposition



this inevitability

Immediate Inference.

one statement *forces a different statement.*

not always this easy

validity and invalidity

was a part of Aristotle's logical program

2 notions

common sense:

Principle of Non-contradiction

Principle of the Excluded Middle

rules of THOUGHT for A.

Principle of non-contradiction

All swans are white

contradicts

Some swans are not white.

Principle of the Excluded Middle

Swans are either
white or not-white

not just good ideas

The Law.

rules about reality

an instruction about how we should reason

argumentation

He had a formula for that.

invalid

P1. If a power reactor leaks radiation, People nearby will get cancer

P2: People nearby get cancer

C. Therefore, the power reactor is leaking radiation

2+1 kinds classical logic

1. deductive

contains a guarantee

2. inductive

(3. abductive)

DEDUCTIVE REASONING

often,

from the universal, to the particular:

- hitting a finger with something hard will cause pain;
- all hammers are hard;
- therefore, if I hit my finger with any hammer, it will hurt.

INDUCTIVE REASONING

often,

from particulars, to a universal:

- hitting my finger with this hammer once hurts;
- hitting my finger with this hammer twice hurts;
- hitting my finger with this hammer three times hurts;
- therefore, all hammers will hurt fingers when hit

BUT, not always:

DEDUCTIVE REASONING

universal + particular -> particular

- hitting a finger with something hard will cause pain;
- this hammer is hard;
- therefore, if I hit my finger with this hammer, it will hurt.

INDUCTIVE REASONING

particular + particular -> particular

- hitting my finger with a hammer once hurts;
- hitting my finger with a hammer twice hurts;
- hitting my finger with a hammer three times hurts;
- therefore, this hammer will always hurt my fingers when hit

1. deductive logic

a discovery

essential for his biology

Let me illustrate: Let

A be a deciduous character,

B the possession of broad leaves,

C Vine.

“

Aristotle

very, very smart

an algebra of phrases

letters to stand for phrases

can generalize to any subject

according to the form of the sentences

“Syllogism”

Hypothetical Syllogism consists of:

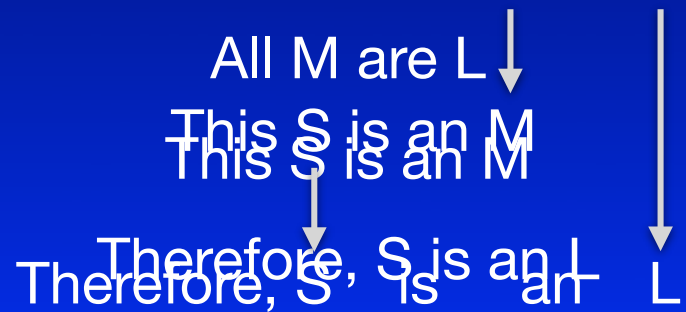
a premise

another premise

a conclusion

“transitive”

one of his 3 “figures” is L



the **structure**

forces the conclusion

can create an algebra of language

for any S, L, or M

Deduction: a tool

for “science”
to avoid ALL fallacies

“Organon”

mathematics?

a deductive system
could cast proofs as syllogisms

syllogistic deduction

All a are b
This c is a
therefore, This c is b

All men are mortal
Socrates is a man
therefore, Socrates is mortal

No a are b
All c are a
therefore, No c are b

No insects are verbal
All ants are insects
therefore, no ants are verbal

- the essential thing about logic: this is a **valid conclusion regardless of what a, b or c are** – the relationship - the sentence structure - is all that matters
- Does this guarantee truth? **NO**. And that becomes an issue.
- Does this tell you something new? **NO**. The conclusion is already existent in the premises.

“valid” ≠ “true”

A is B
C is B
A is C



P1. People who can fly have super powers
P2. Clark Kent has super powers
P3. Therefore, People who fly are Clark Kent

A is B
C is A
C is B



P1. People with super powers can fly
P2. Clark Kent has super powers
P3. Therefore, Clark Kent can fly.

another kind of syllogism

“modus ponens”

two items:

if p is true, then q is true

p is true

therefore, q is true

substitute
sentences for p
and q

the power reactor

- P1. If a power reactor leaks radiation, people nearby will get cancer
- P2. People nearby get cancer
- C. Therefore, the power reactor is leaking radiation

p is q
 q
 p

one of the well-known logical fallacies: *Affirming the Consequent*

- P1. If a power reactor leaks radiation, people nearby will get cancer
- P2. The power reactor leaks radiation
- C. People nearby will get cancer

p is q
 p
 q

valid: Modus Ponens

↑
two items, always true...hmmm

if $p \rightarrow q$ is true, and p is true, then q is true

p = raining, T or F

q = wet, T or F

4 conditionals:

if it is raining, then the ground is wet

if it is raining, then the ground is not wet

if it is not raining, then the ground is wet

if it is not raining, then the ground is not wet

truth tables

associated with Ludwig Wittgenstein ~1921



raining	wet	seem right?	p	q	$p \rightarrow q$
yes	yes	yes	T	T	T
yes	no	no	T	F	F
no	yes	can't judge	F	T	T
no	no		F	F	T

more truth tables

AND

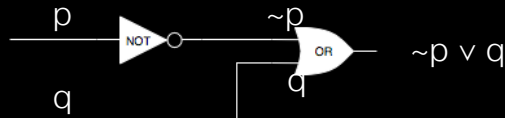
p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

OR... now using 0 and 1

p	q	$p \vee q$
1	1	1
1	0	1
0	1	1
0	0	0

$p \rightarrow q \equiv \sim p \vee q$

p	q	$p \rightarrow q$	not- p	not- $p \vee q$
1	1	1	0	1
1	0	0	0	0
0	1	1	1	1
0	0	1	1	1



digital logic

was anticipated in Aristotle's "algebra" of statements

and actually taken a long way in 17thC

Gottfried Leibnitz

2. induction

Aristotle used one kind:

Induction by Enumeration

A_1	has property	X
A_2	has property	X
A_3	has property	X
	therefore, all A's have property X	

there are others

Medievals found some
John Stuart Mill classified 5

instances	circumstance	effect
trial 1	ABCD	X
trial 2	CDH	X
trial 3	ABECD	X
trail 4	FGC	X

therefore, you can reasonably conclude that X can be the effect of C

called the “Method of Agreement”

so much for common
sense

Fuzzy logic
neural nets

Logic is important and modern.

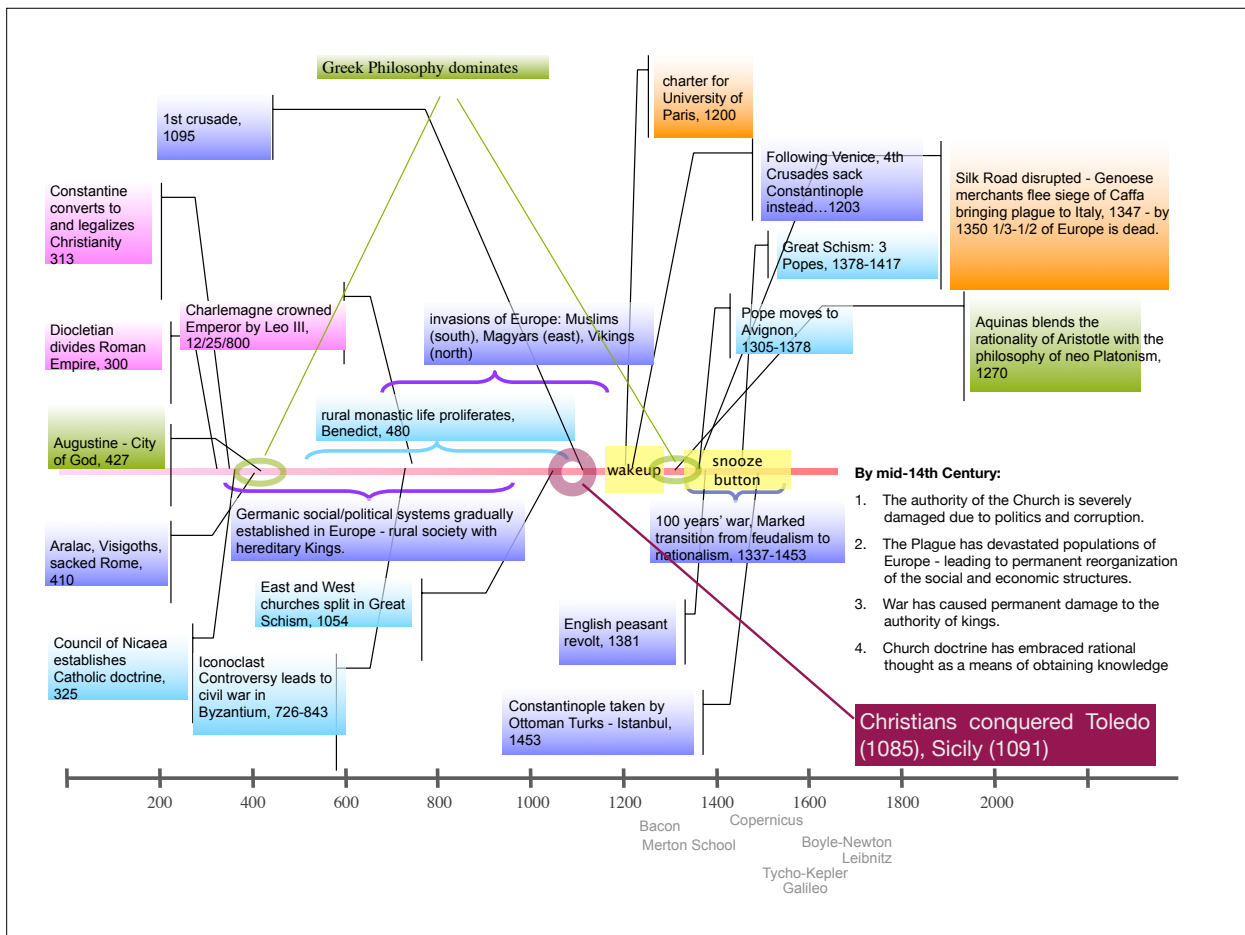
back to the story

a route to Truth

sylogism infallible

unrelated to scripture

1120: Peter Abelard, *Sic et Non*



“ Ignorant themselves of the forces of nature and wanting to have company in their ignorance, they don't want people to look into anything; they want us to believe like peasants and to not ask the reason behind things...”

William of Conches, c1120

Church vs Aristotle

faith and abstractions

VS

reason and logic

by 1200: the
radical enclaves

the



of Aristotelianism

universities

Bologna, Paris, Oxford, Padua

Church took it well

1210: banned teaching of Aristotle

ignored

sent in the troops to Paris

Dominicans (1217); Franciscans (1230)

1255: okay. 1277: not okay

Theology & Philosophy

becoming 2 separate subjects

into Paris rode



Thomas Aquinas
1225-1274

Before Thomism

revelation reason

nothing but trouble

1311 "Thomism"

revelation

reason

served Catholicism
until the Vatican
Council II



little sister.

Scholasticism

1200's

a Method of argument

disputation

authoritarian

“schoolmen”

academia became

s o l i d i f i e d

Aristotle=Authority

“The Philosopher”

their version of Aristotle

scripture.

e.g. @Uof P: Condemnations of 1277

intellectualism?

Franciscans and Dominicans

Roger Bacon

1213-1294

he looked

Franciscan at Oxford



“

...reasoning does not suffice, but **experience** does.

Roger Bacon



experiments

among the first
with Grosseteste
esp optics

tests of hypotheses

Ockham

1280-1349

“universals”? abstractions

explain experience without reference to Universals

the razor



not.

well, maybe

Edward I & Philip the Fair

vs

Boniface VIII

3 rounds

knockout

“

My master's sword is made of steel. The Pope's is made of verbiage.

Philip's minister, 1301

them's fighting words

jubilee year, 1300+3

Pope dead

papacy in tatters

war, famine, anarchy to follow



the first intellectual reaction

against authoritarianism

humanism

Francesco Petrarca

aka Petrarch (1304-1374)



self-aware of his era

individual accomplishment
“correspondence” with Ancients

“It is foolhardy...to accept an engagement with these fellows [schoolmen] upon their own terms. It is indeed from the fighting itself that they derive their chief pleasure: their object is not to discover the truth, but to prolong the argument...How do we escape from these maniacs? ...no one could be more utterly different from that great philosopher [Aristotle] than a man who writes nothing, knows little, and constantly indulges in much vain declamation? Who does not laugh at their trivial conclusions...not only are they good for nothing else, but their perverted activity renders them actually harmful. ...if your friend begins to vomit forth syllogisms, I advise you to take flight.

Petrarch

in the air

introspection

tendency toward independence

humanism

almost proto-scientific observation of

human behavior

experience

history encouraged

first time since Romans

individual

heroic cast...

going it alone

“

I, for my part, know no greater pleasure than listening to an old man of uncommon prudence speaking of public and political matters that he has not learned from books of philosophers, but **from experience and action**; for the latter are **the only genuine methods of learning anything**.

Francesco Guicciardini (1483-1540)

“

[God said] The nature of all other things is limited and confined within laws which I have laid down. You, **confined by no limits, will determine your nature for yourself by your judgment**....as a free and sovereign craftsman, you may mold yourself whatever you choose. You will be able to degenerate into those lower creatures, which are brutes; you will be able, by the determination of your mind, to be reborn into those higher creatures, which are divine.

Pico della Mirandola, 1464-1495

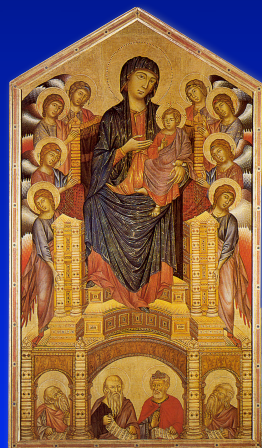
a break-point in art

Bacon-Edward-Philip-Boniface timeframe

Cimabue (1250-1300)



Mother of God and Protectress of the Church, Church of Our Lady of the Pharos, Constantinople, 11C



Maesta di Santa Trinita, Cimabue, 1280

Florence & Siena



Maesta, Duccio, 1308...the main panel of a large altarpiece

Giotto

(1268-1336)

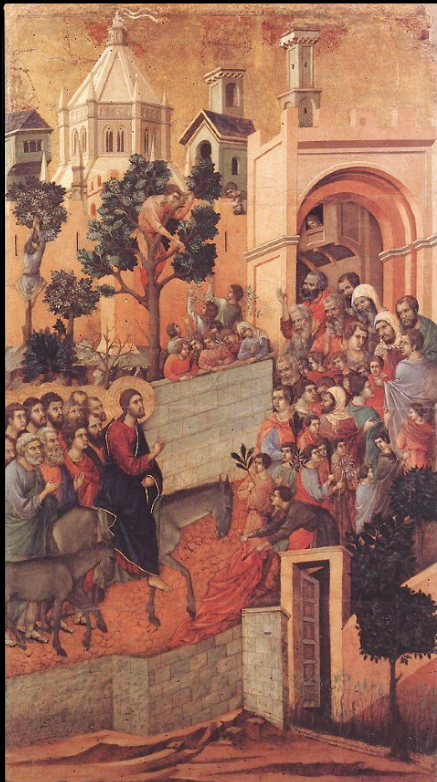


Giotto di Bondone
1268-1336

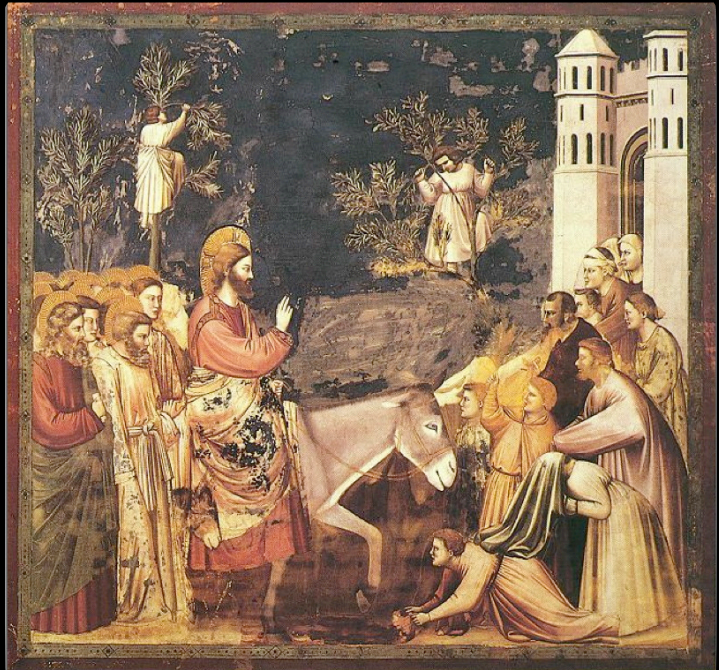
Madonna d'Ognissanti, Giotto, 1310



Faith, Giotto, 1305



Duccio, Christ Entering Jerusalem,
from back of Maesta, 1308



Giotto, Christ Entering Jerusalem, Arena Chapel, ~1305



Meeting at the Golden Gate, Giotto, 1304-06, Cappella dell'Arena, Padua



Ambrogio Lorenzetti, *Allegory of Good Government: Effects of Good Government in the City and the Country*, 1338-39



Ambrogio Lorenzetti, *Allegory of Good Government: Effects of Good Government in the City and the Country*, 1338-39

in the north as well...



Broederlam, *The Annunciation and the Visitation*
1393-99

international Gothic

English, Flemish, French, Italian



Wilton Diptych
Richard II kneeling

The flowers, the ring, the lamb, the gesture of the Child - all symbolic

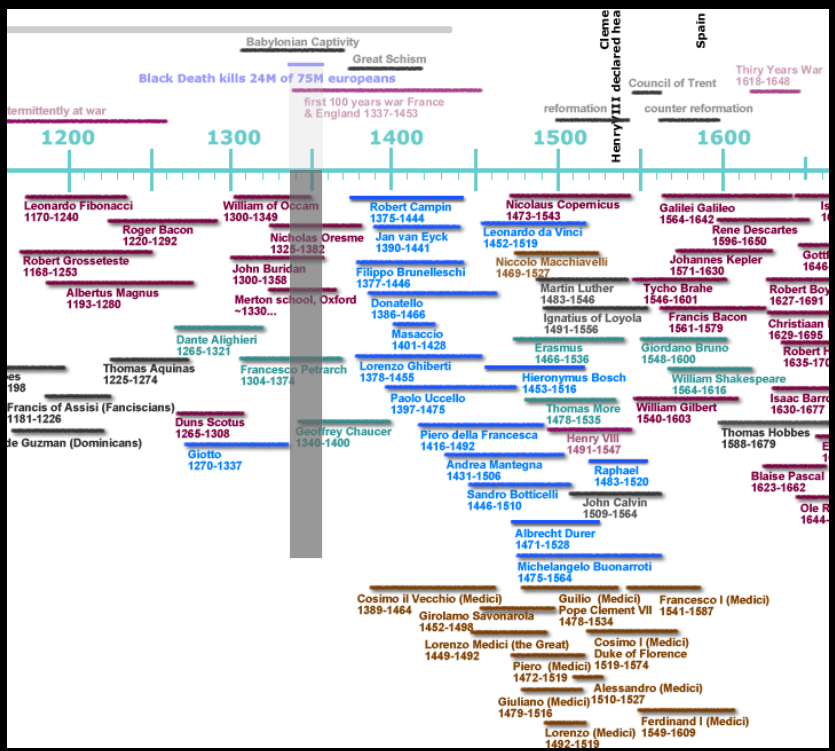
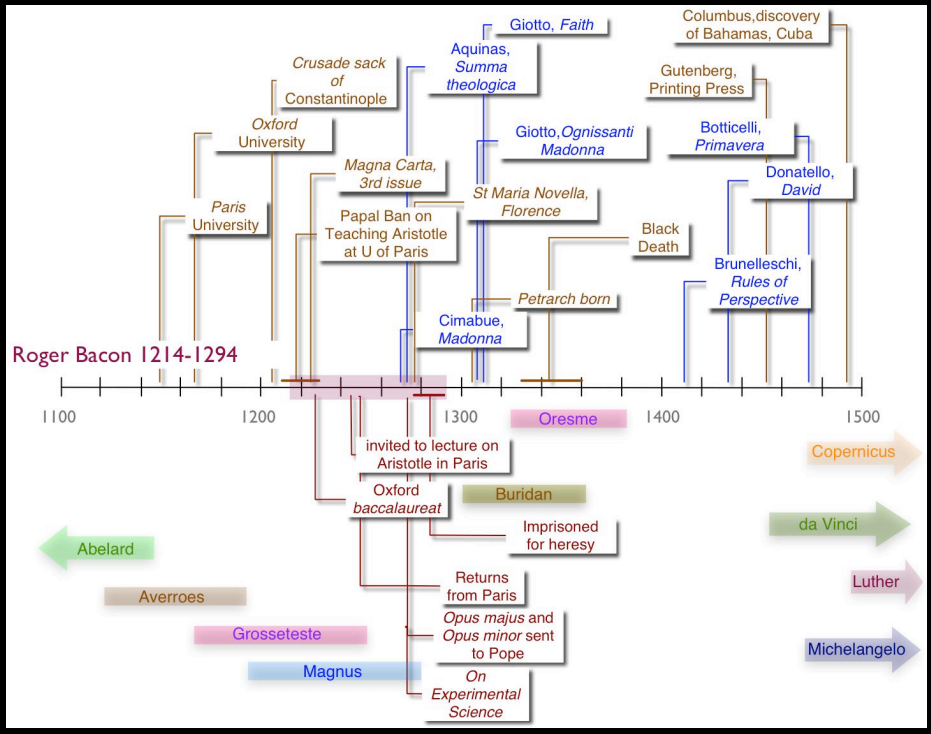


Limbourg Brothers, July, from *Les Très Riches Heures du Duc de Berry*, 1413



Conrad Witz, *Christ Walking on the Water*, 1444.

Again, showing the ambiguity of time as perceived by the medieval mind



Doctors in Paris ascribed it to a triple conjunction of Saturn, Jupiter, and Mars in the 40th degree of Aquarius said to have occurred on March 20th, 1345.

thinking for one's
self

ie. *beyond* Aristotle
natural science also

air & water?

a mover?

&

something that can be moved?

projectiles?

goofy

“

...some incorporeal motive force is imparted by the projector to the projectile, and ...the air set in motion contributes either nothing at all, or else very little to this motion of the projectile.

John Philoponus, 6th C



1350

John Buridan, rector U. of P.

collected silly Aristotelian physics examples:

spinning top, spear pointed at both ends, spear thrown with blunt end first, sailor at the bow of a ship feels breeze on front, not back

“impetus”

something communicated to a projectile

Oxford & Paris

motion

Oresme, 1377

every measurable thing can be thought of as
a continuous quantity

“strength” of a
property

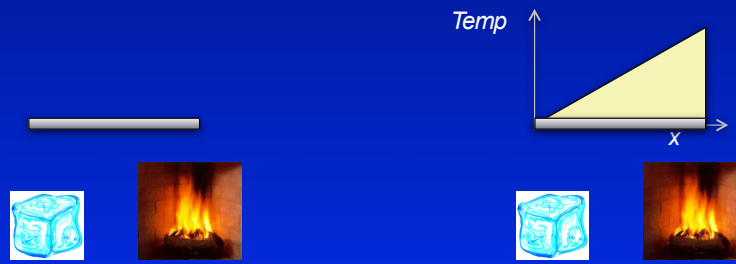
represented graphically

Intensity of Quality

&

Quantity of that Quality

“Extension” of the intensity



a “motion,” remember?

locomotion

For A:

quantifiable were distance & time

not speed

locomotion

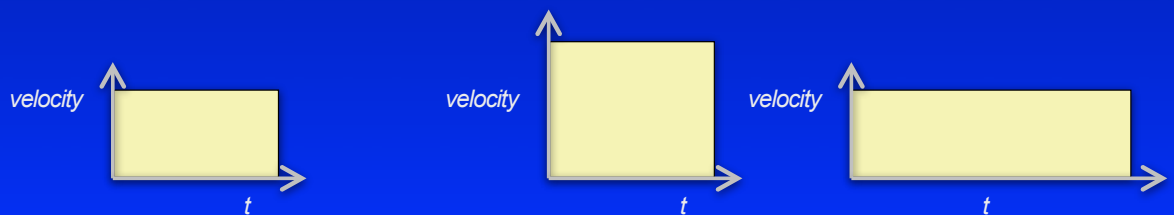
for Oresme

speed is an Intensity of Locomotion
like temperature is Intensity of heating

distance

“Total Quantity” of Motion

the area of the graph



makes sense!

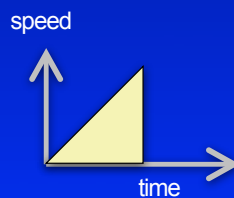
Oxford's Merton School

almost...acceleration



“uniformly difform” motion

uniform increase in speed in time



falling bodies:

something about the object increased
impetus active in natural motion?

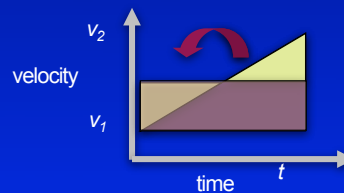
Merton mean speed theorem

Suppose an object undergoes uniformly difform motion...
the Merton mathematicians argued that

the distance traveled is the area...

By construction, they found that area by breaking the triangle into a rectangle of height equal to the midpoint...

two graphs, two kinds of motions, one constant, one difform - equal distances



Two motions: uniform and difform...related by the average speed

We can prove this today, just using geometry... The area of the triangle is

$$d_T = 1/2(v_2 - v_1)t.$$

Notice, that the average speed over this same interval is

$$\bar{v} = 1/2(v_2 + v_1).$$

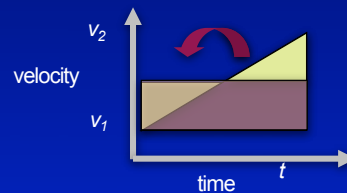
Just algebra: eliminating v_2 in favor of \bar{v} gives

$$\begin{aligned} d_T &= 1/2t(2\bar{v} - v_1) - 1/2tv_1 \\ d_T &= \bar{v}t - v_1t \end{aligned}$$

Now, suppose that another object travels at a uniform speed equal to that midpoint on the triangle, \bar{v} , then the distance traveled would be

$$d_R = \bar{v}t - v_1t$$

... which is the same.



description of motion

geometrical

graphical

mathematical in spirit

brand new

BUT: no measurements

no “why”

...if a stone is thrown vertically...it would be rapidly carried to the east “together with the air through which it passes and with all the mass of the lower part of the World” ... which participates in the diurnal motion. The stone links its motion with that of the Earth, which gave it impetus to move with it.

Oresme

If a man were placed in the Heavens, suppose that he were moved with a diurnal [daily] motion...it will seem to him that the Earth is moved diurnally [daily] just as, to us on the Earth, the Heavens seem to move. And similarly, if the earth is moved with a diurnal motion and the Heavens not, it will seem to us that the Earth is still and that the Heavens move.

Oresme
bingo

3 cracks in Aristotle's armor

1. projectiles
2. speed as quantity
3. stationary earth