



**FOUR HORSEMEN  
OF THE APOCALYPSE  
CLIMATIC PROBLEMS, FAMINE,  
DISEASE, WAR AND DEATH**

**542-1550 AND BEYOND**

*INSIGHT-SCIENTIFIC AMERICAN*

**DR. PATRICK HUNT**

**STANFORD UNIVERSITY**

What *are* the Four  
Horsemen of the  
Apocalypse?



*What were, are and will be*  
the Four Horsemen of  
the Apocalypse?



## *Revelation 6:1-7*

1 "I watched as the Lamb opened the first of the seven seals. Then I heard one of the four living creatures say in a voice like thunder, "Come!" 2 I looked, and there before me was a white horse! Its rider held a bow, and he was given a crown, and he rode out as a conqueror bent on conquest.

3 When the Lamb opened the second seal, I heard the second living creature say, "Come!" 4 Then another horse came out, a fiery red one. Its rider was given power to take peace from the earth and to make men slay each other. To him was given a large sword.

5 When the Lamb opened the third seal, I heard the third living creature say, "Come!" I looked, and there before me was a black horse! Its rider was holding a pair of scales in his hand. 6 Then I heard what sounded like a voice among the four living creatures, saying, "A quart of wheat for a day's wages, and three quarts of barley for a day's wages, and do not damage the oil and the wine!"

7 When the Lamb opened the fourth seal, I heard the voice of the fourth living creature say, "Come!" 8 I looked, and there before me was a pale horse! Its rider was named Death, and Hades was following close behind him. They were given power over a fourth of the earth to kill by sword, famine and plague, and by the wild beasts of the earth."





Pieter Bruegel the Elder, *The Harvesters* detail 1565 Met. Museum New York 119 x 162 cm





Nineveh: Assyrian Lachish relief, circa 700 BCE British Museum





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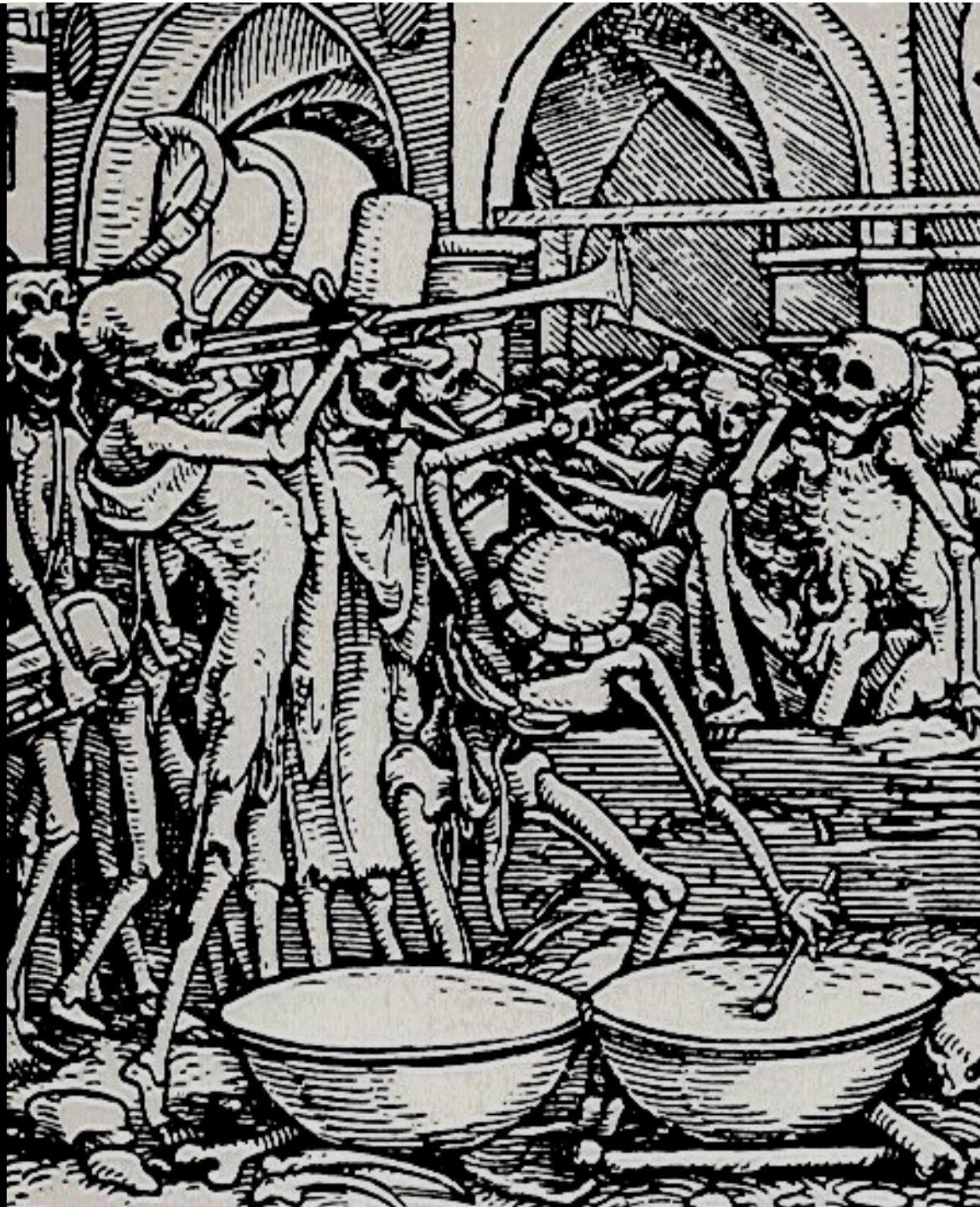
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*Death Assailing a Young Man*

Giovanni di Paolo c. 1443





*Triumph  
of Death*

15<sup>th</sup> c.  
woodcut





Boccaccio's *Decameron* 1350



## The Black Death    Bubonic Plague?

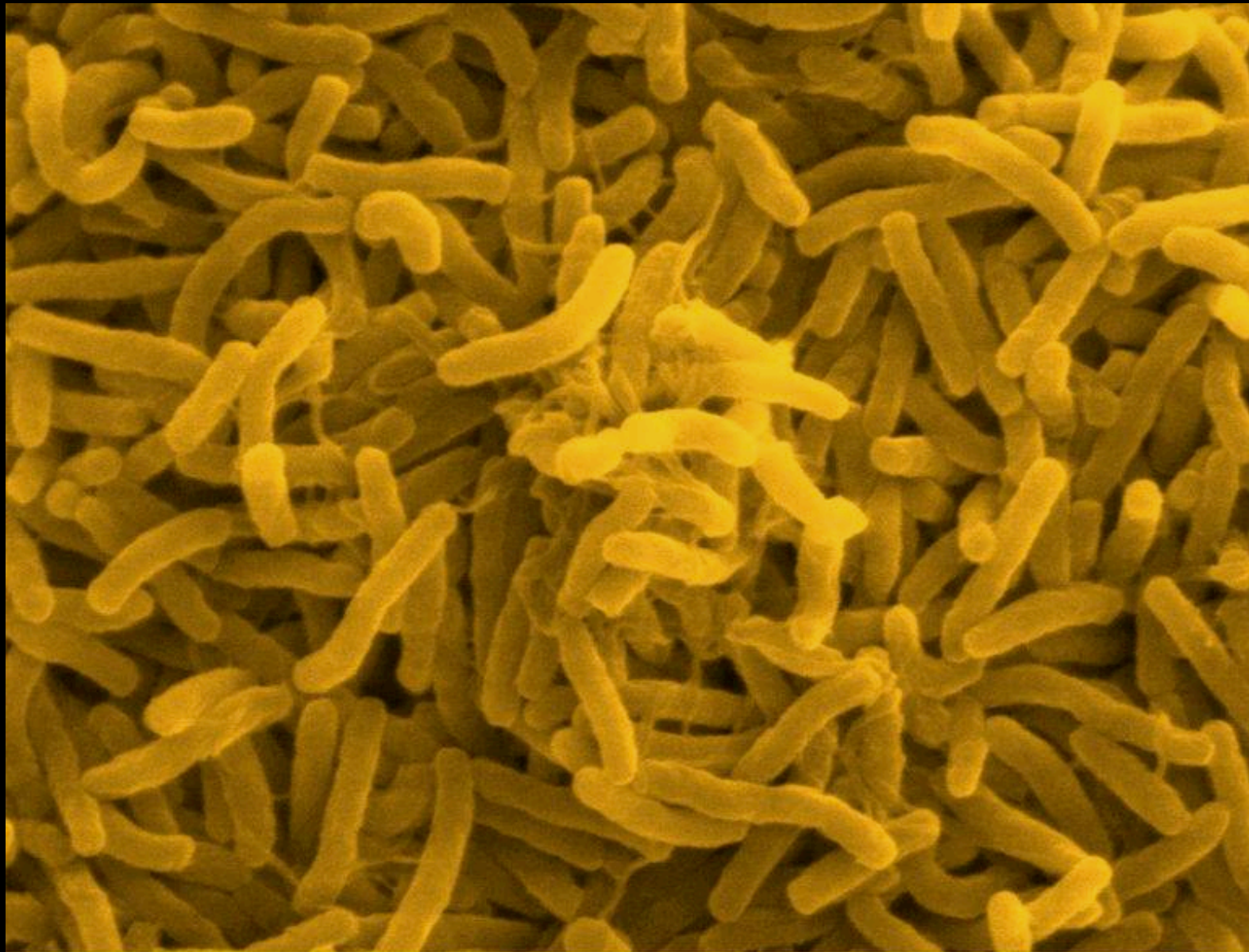
“Thirty million people died of plague in Europe in a four-year period between 1347-51. The trend of recent research is pointing to a figure of 45% to 50% of the European population dying during this time. There is a fair amount of geographic variation. In Mediterranean Europe and Italy, the South of France and Spain, where plague ran for about four years consecutively, it was probably closer to 75% to 80% of the population. In Germany and England it was probably closer to 20%.”

*Philip Daileader, 2007*



Hannibal lost almost half his army crossing the Alps in 218 BCE





1 μm

Cholera1

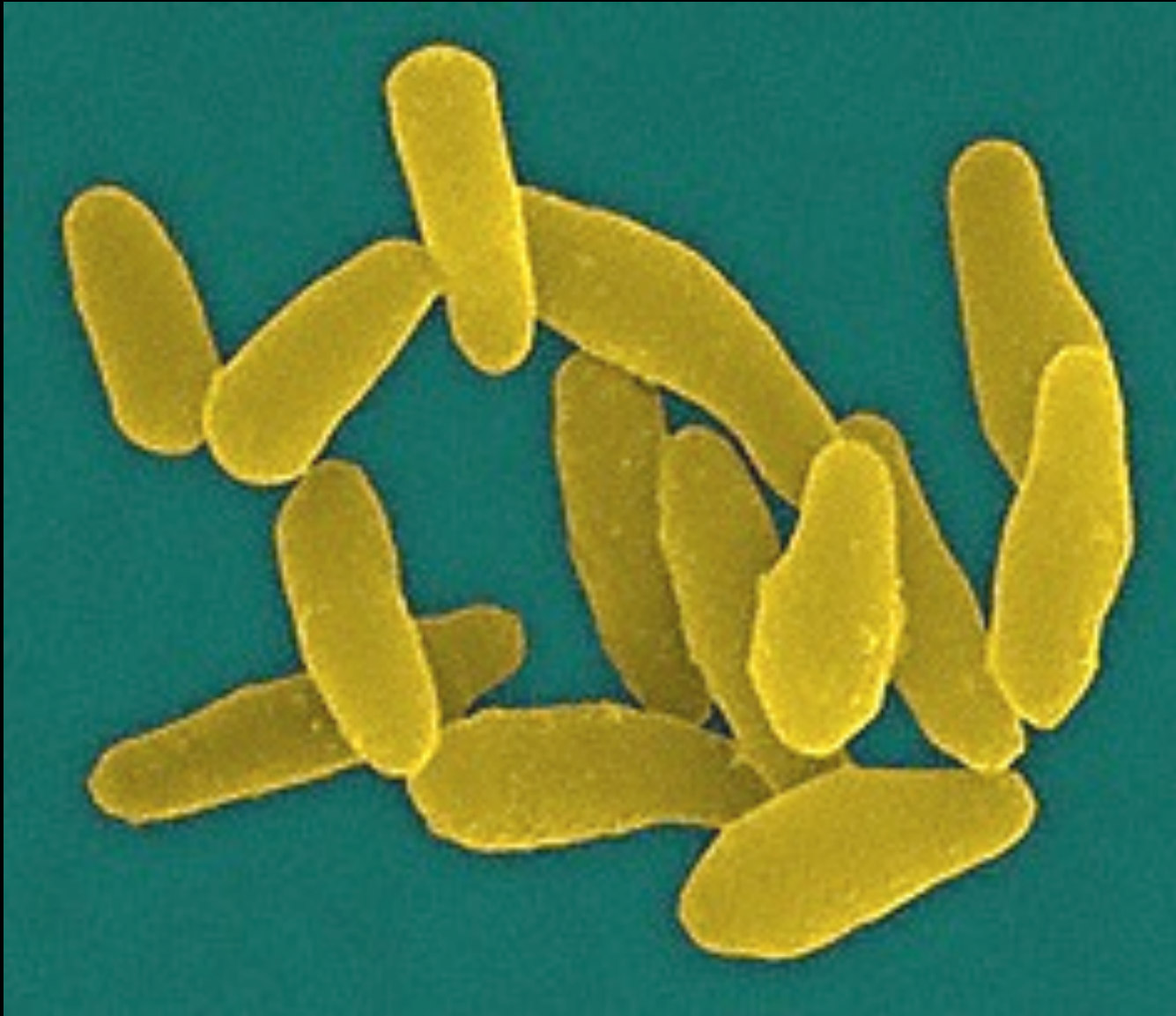
1/6/0 REMF

CHOLERA is caused by *Vibrio cholerae*, and quickly brings about a severe diarrhea that can completely dehydrate and kill a human in as little as 4-6 hours. Blood types are now also thought to be important, as Type O is least resistant and Type AB most resistant. Fatality is often 50% without treatment.

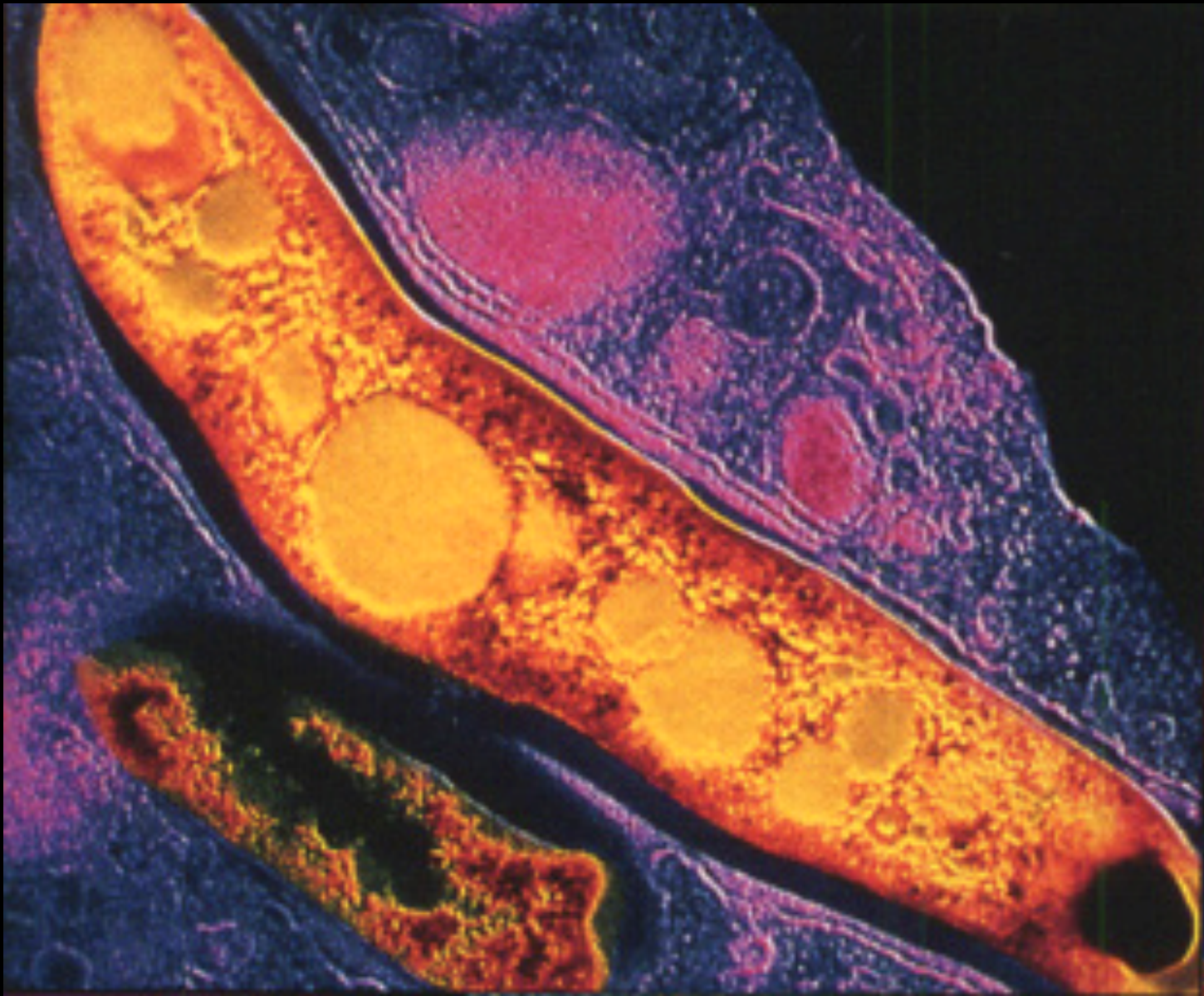


TYPHOID FEVER is caused by *Salmonella enterica typhi* and it typically has a human reservoir. It is usually transmitted by drinking (oral ingestion) or immersion in water that has been contaminated by fecal matter, especially in drinking water. Typhoid fever has a range of incubation between 5-21 days. Typical symptoms include enteric fever, abdominal pain, uncontrollable diarrhea and flushed or patches of rosy skin spots.





DIPHTHERIA has symptoms including persistent sore throat, mucous membrane swelling and is followed by death by suffocation. Diphtheria is caused by *Corynebacterium diphtheriae* toxin. Especially dangerous in close proximity where people are massed together, humans are the reservoir, and the transmission is made by close contact. It has a short incubation period of 2-8 days, which makes it a potential candidate for an epidemic within the described conditions during the army campaign of Hannibal.



**TUBERCULOSIS:** There is longstanding evidence of spinal TB in human remains of early Egyptian contexts, corroborating that this disease was ancient and most likely affected humans worldwide since at least the Early Bronze Age in the Mediterranean regions (3000-2200 BCE) (Morse, Brothwell, Ucko, 1964). Tuberculosis is caused by *Mycobacterium tuberculosis*, and symptoms include fever, persistent cough (with blood traces), chills, increasing weight loss and hemoptysis.





TYPHUS is caused by *Rickettsia prowazekii* through a parasitic insect vector (flea or louse) (via bite, defecation, or internalized by a scratch). Infection is enhanced by the potential environmental conditions during military campaigns (wintry climate, some famine, lack of bathing/adequate hygiene or sanitation). Typhus has a short incubation time (one week) and a low fatality (2.6-3.8%) when present by itself. Its typical symptoms include a high fever of intense and abrupt onset, chills, headaches, and skin rashes.

What can cause dramatic  
short term climatic change?



# Weather and Climatic Events of 535 AD/CE

## Michael the Syrian:

*“The Sun became dark and its darkness lasted for eighteen months. Each day it shone for about four hours, and still this light was only a feeble shadow...the fruits did not ripen and the wine tasted like sour grapes.”*

## Priscianus Johannes Lydus (Constantinople):

*“The Sun became dim...for nearly the whole year...so that the fruits were killed at an unseasonable time.*

## Gildas, *De Excidio Britonum* 93.3 (*Annales Cambriae*) Anglo-Saxon

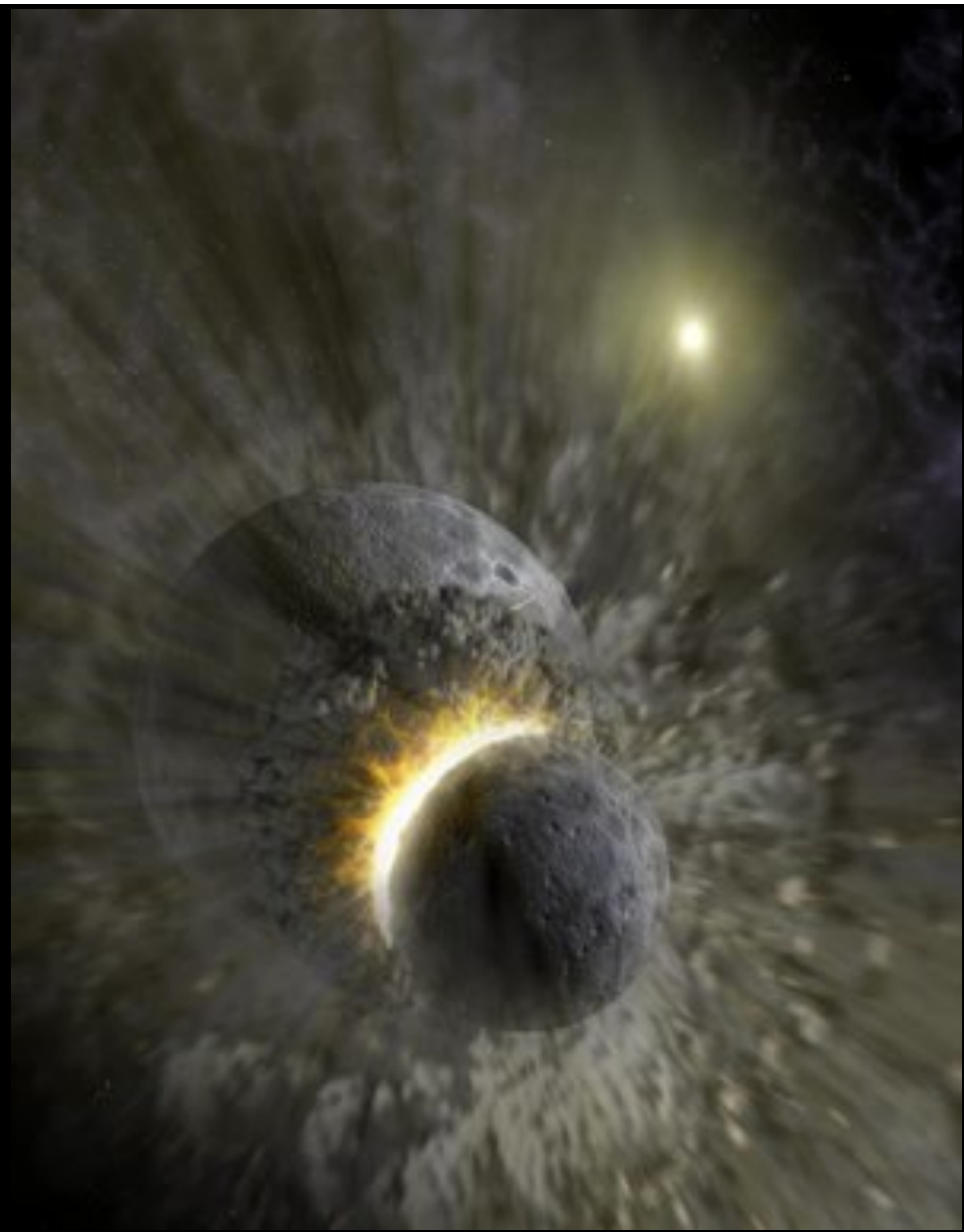
*“There was a mysterious cloud that obscured the sun and moon for a whole year...”*

## Scandinavian-Baltic Fimbulwinter, “Twilight of the Gods”:

*“...the sunshine and the summer had somehow lost their glory, and were thenceforth pale and faint. At last there came a winter such as neither man nor god had ever seen before. The days were short and dark, blinding storms followed fast upon each other and left mountains of snow behind, fierce winds swept the sky and troubled the sea, and the bitter air froze the very hearts of men into sullen despair. The deepest rivers were fast bound, the fiercest animals died in their lairs, there was no warmth in the sun, and even the icy brightness of the stars was dimmed by drifting snow. The whole earth was buried in a winter so bitter that the gods shivered in Asgard...”*



Volcanic Plinian eruption of Krakatoa 535 CE

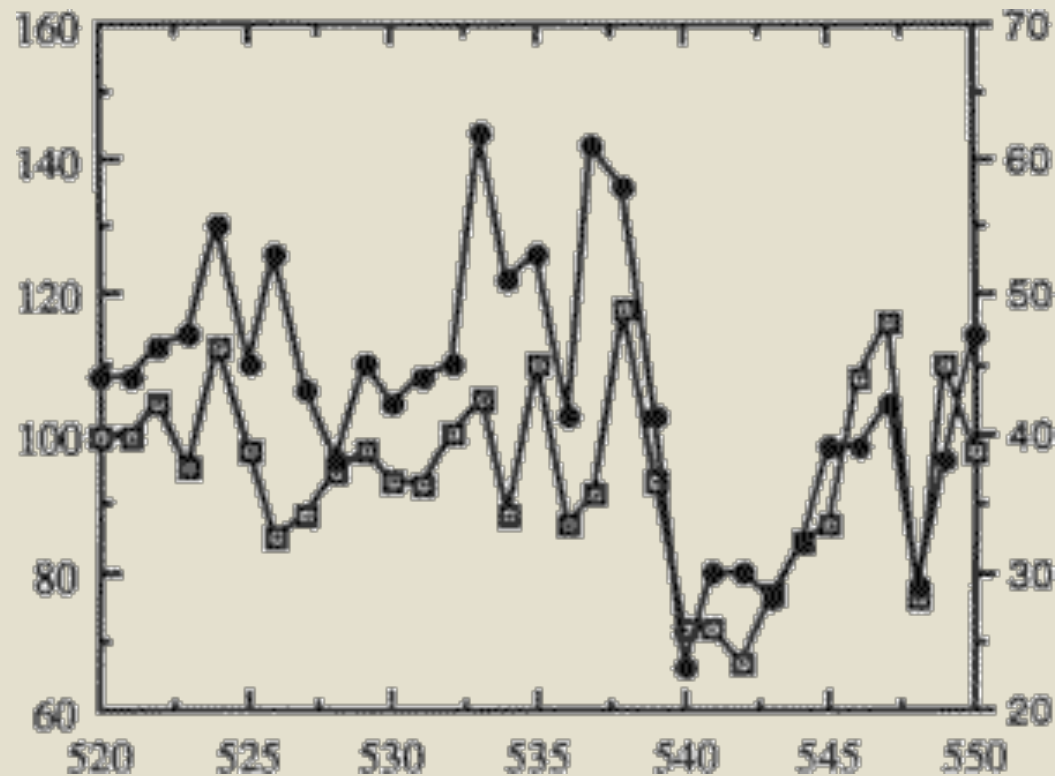


Comet Collision over or on the Earth 535 CE

*Astronomy and Geophysics*, Journal of Royal Astronomy Society, Cardiff University School of Physics and Astronomy, Feb. 2004



## Corresponding Bioarchaeology and Collapse of the *Pax Britannica* (Fall of Arthurius)



Restricted Growth in Oaks from Belfast (solid dots) and Whithorn (squares) (after Baillie 1995:95)

M.G.L. Baillie (1995). *A Slice through Time: Dendrochronology and Precision Dating*. London: Batsford.

“The Great Famine and the Collapse of the *Pax Britannica*.” *Journal of Celtic Cultural Studies* (2003)  
Prof. T. D. Griffen. Foreign Languages and Literature, Southern Illinois University

# Chunguska, Siberia 1908



C. F. Chyba, P. J. Thomas and K. J. Zahnle

“The 1908 Tunguska Explosion: Atmospheric Disruption of a Stony Asteroid”.

*Nature* 361 (1993), 40-44

asteroid above Siberia 30 meters in diameter traveling at about 15 km/sec



Procopius *History of the Vandal Wars*, III.xiv.5-10 536 AD/CE

“...And it came about during this year that a most dread portent took place. For the sun gave forth its light without brightness, like the moon, during this whole year, and it seemed exceedingly like the sun in eclipse, for the beams it shed were not clear nor such as it is accustomed to shed. And from the time when this thing happened men were free neither from war nor pestilence nor any other thing leading to death. And it was the time when Justinian was in the tenth year of his reign...”

Why? Fruit froze on trees and it snowed in August. The volcano Krakatoa had exploded in 535, sending millions of cubic feet of volcanic ash and dust into the atmosphere. A comet collision with earth had also diffused over the planet trillions of spherules that show up in Greenland ice layers.

Constantinople  
in Justinian's reign

c. 540 AD/CE

## The Plague of Justinian

What vector[s] caused this  
plague to move from Africa  
north along the Nile and into  
the Mediterranean?

Climatic change...

Ship traffic was its primary long  
distance vehicle after 538 AD/CE





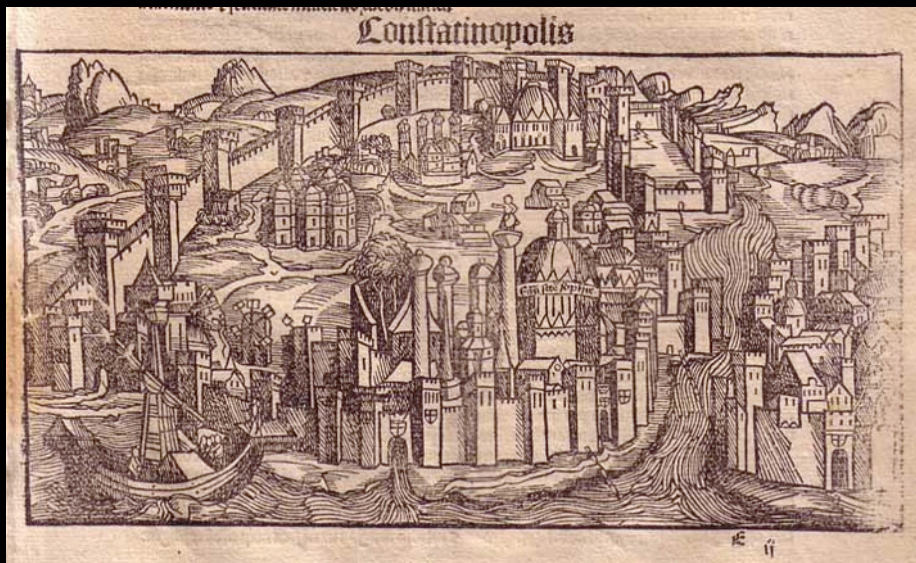
## Procopius, *History of the World*, 542 AD/CE

“During these times there was a **pestilence, by which the whole human race came near to being annihilated**...Some explanation of a cause might be given by daring men, such as the many theories propounded by those who are clever in these matters; for they love to conjure up causes which are absolutely incomprehensible to man, and to fabricate outlandish theories of natural philosophy knowing well that they are saying nothing sound but considering it sufficient for them...But for this calamity it is quite impossible either to express in words or to conceive in thought any explanation, except indeed to refer it to God. For it did not come in a part of the world nor upon certain men, nor did it confine itself to any season of the year...but it embraced the entire world, and blighted the lives of all men, though differing from one another in the most marked degree, respecting neither sex nor age...And it attacked some in the summer season, others in the winter, and still others at the other times of the year...It started from the **Egyptians** who dwell in Pelusium. Then it divided and moved in one direction towards **Alexandria** and the rest of Egypt, and in the other direction it came to Palestine on the borders of Egypt; and from there it spread over the whole world, always moving forward and travelling at times favorable to it...And this disease always took its start from the **coast**, and from there went up to the interior. And in the second year it reached **Byzantium** in the middle of spring...

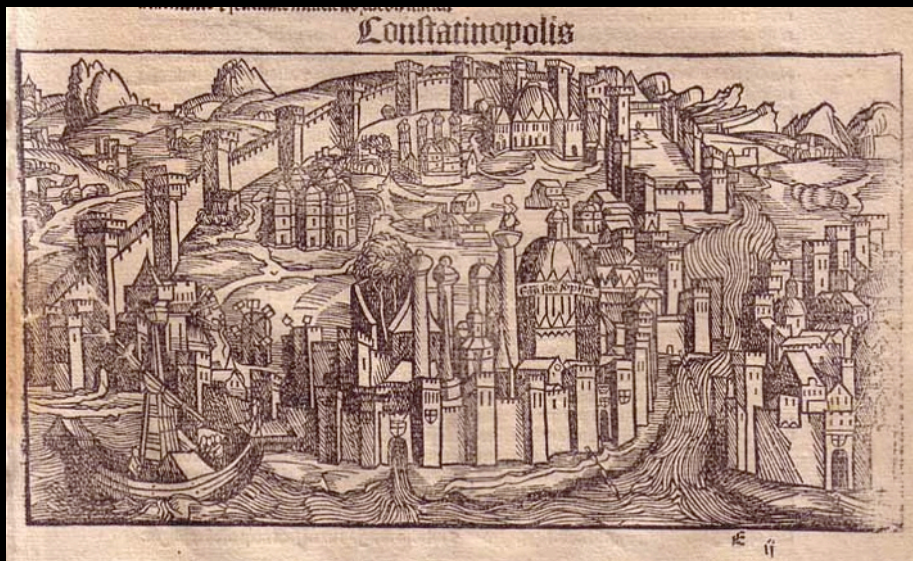
## Procopius, *History of the World*, 542 AD/CE

“...But with the majority it came about that they were seized by the disease without becoming aware of what was coming either through a waking vision or a dream. And they were taken in the following manner. They had a **sudden fever**, some when just roused from sleep, others while walking about, and others while otherwise engaged, without any regard to what they were doing. And the body showed no change from its previous color, nor was it hot as might be expected when attacked by a fever, nor indeed did any inflammation set in, but the fever was of such a languid sort from its commencement and up till evening that neither to the sick themselves nor to a physician who touched them would it afford any suspicion of danger. It was natural, therefore, that not one of those who had contracted the disease expected to die from it. But on the same day in some cases, in others on the following day, and in the rest not many days later, a **bubonic** swelling developed; and this took place not only in the particular part of the body which is called *boubon*, that is, "below the abdomen," but also **inside the armpit**, and in some cases also beside the ears, and at different points on the thighs...And at first the deaths were a little more than the normal, then the mortality rose still higher, and afterwards the tale of dead reached **five thousand each day**, and again it even came **to ten thousand** and still more than that. Now in the beginning each man attended to the burial of the dead of his own house, and these they threw even into the tombs of others, either escaping detection or using violence; but afterwards **confusion and disorder everywhere** became complete. and **many houses became completely destitute** of human inhabitants.”





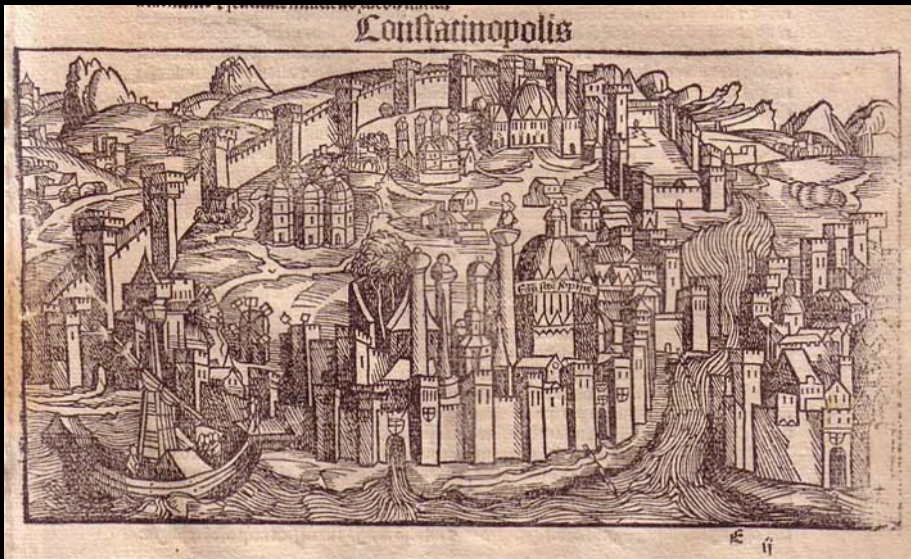
500,000 in 540 AD/CE but by 600 AD = 300,000 (40% loss)



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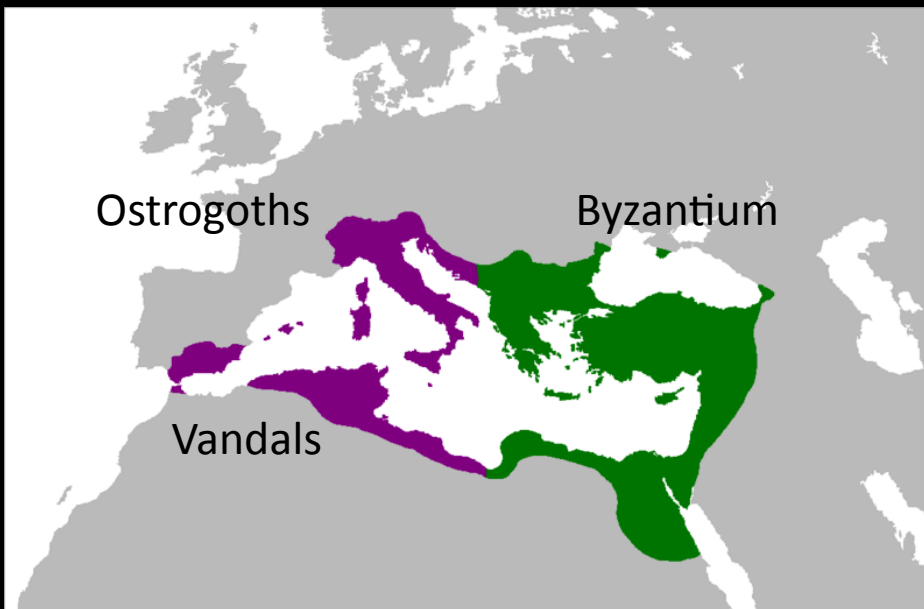
560 AD/CE



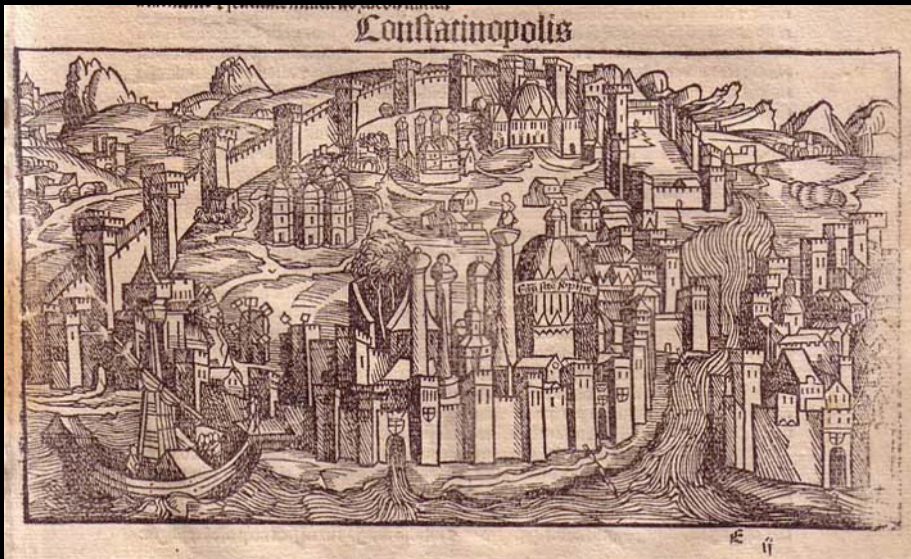


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560 AD/CE

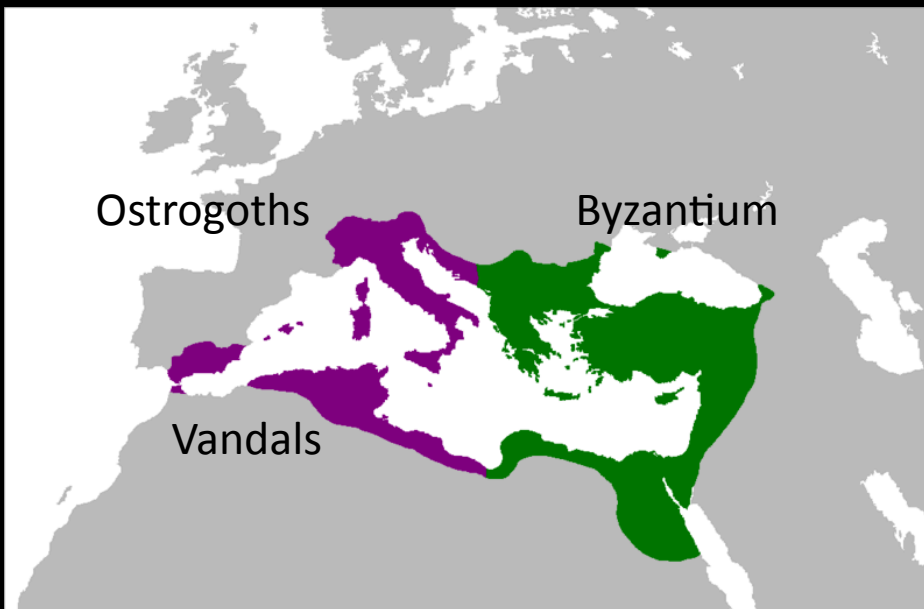


600 AD/CE

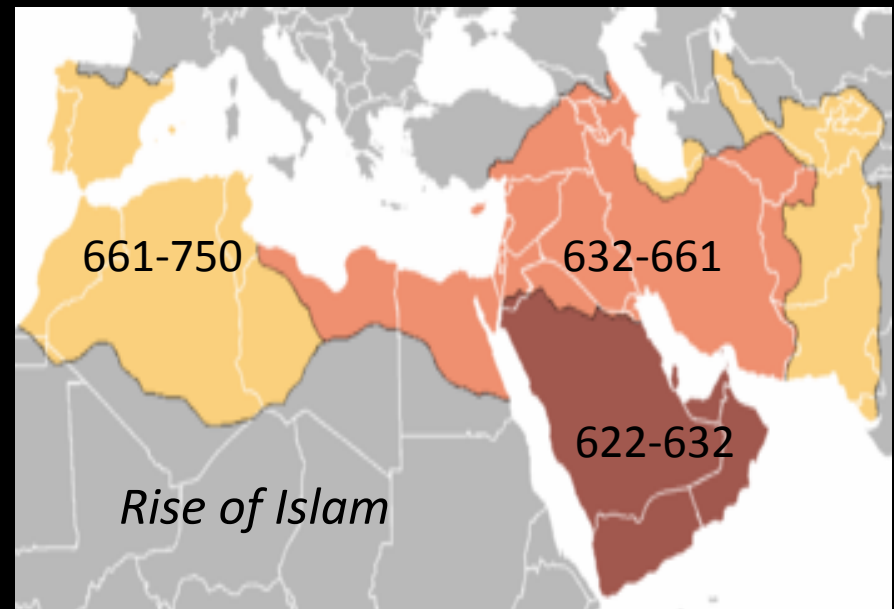


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560 AD/CE



600 AD/CE

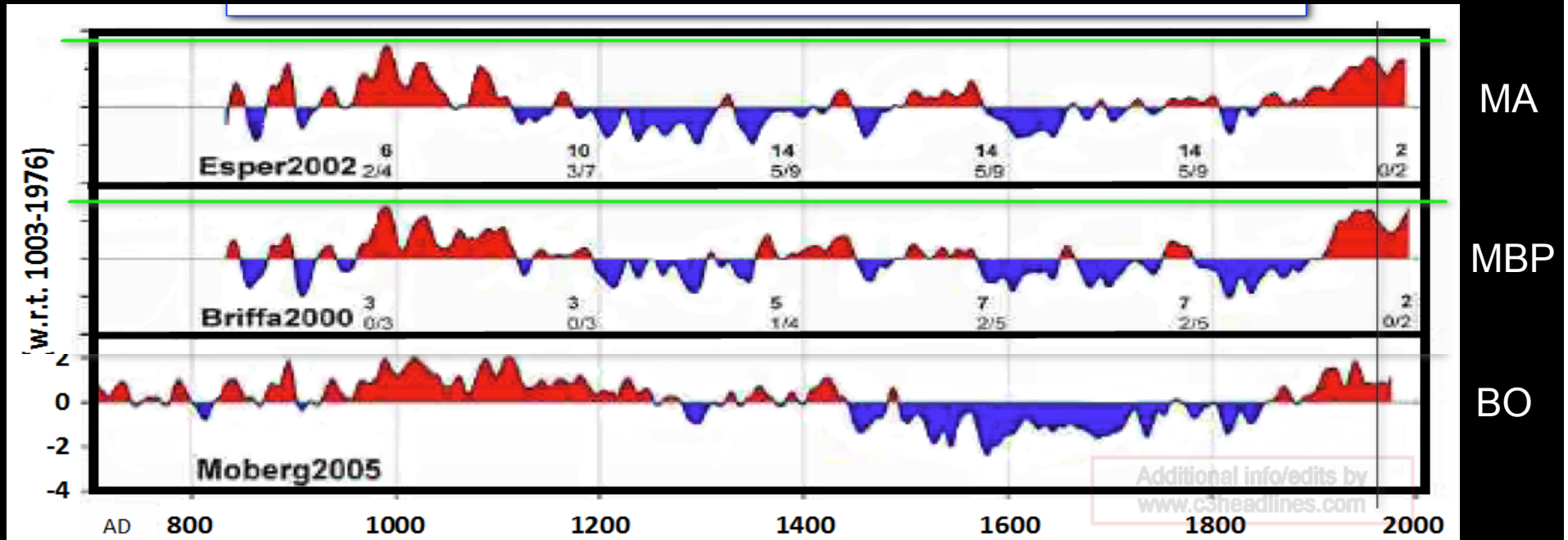


620 CE onward



*Move forward 700 years  
from the Dark Ages...*

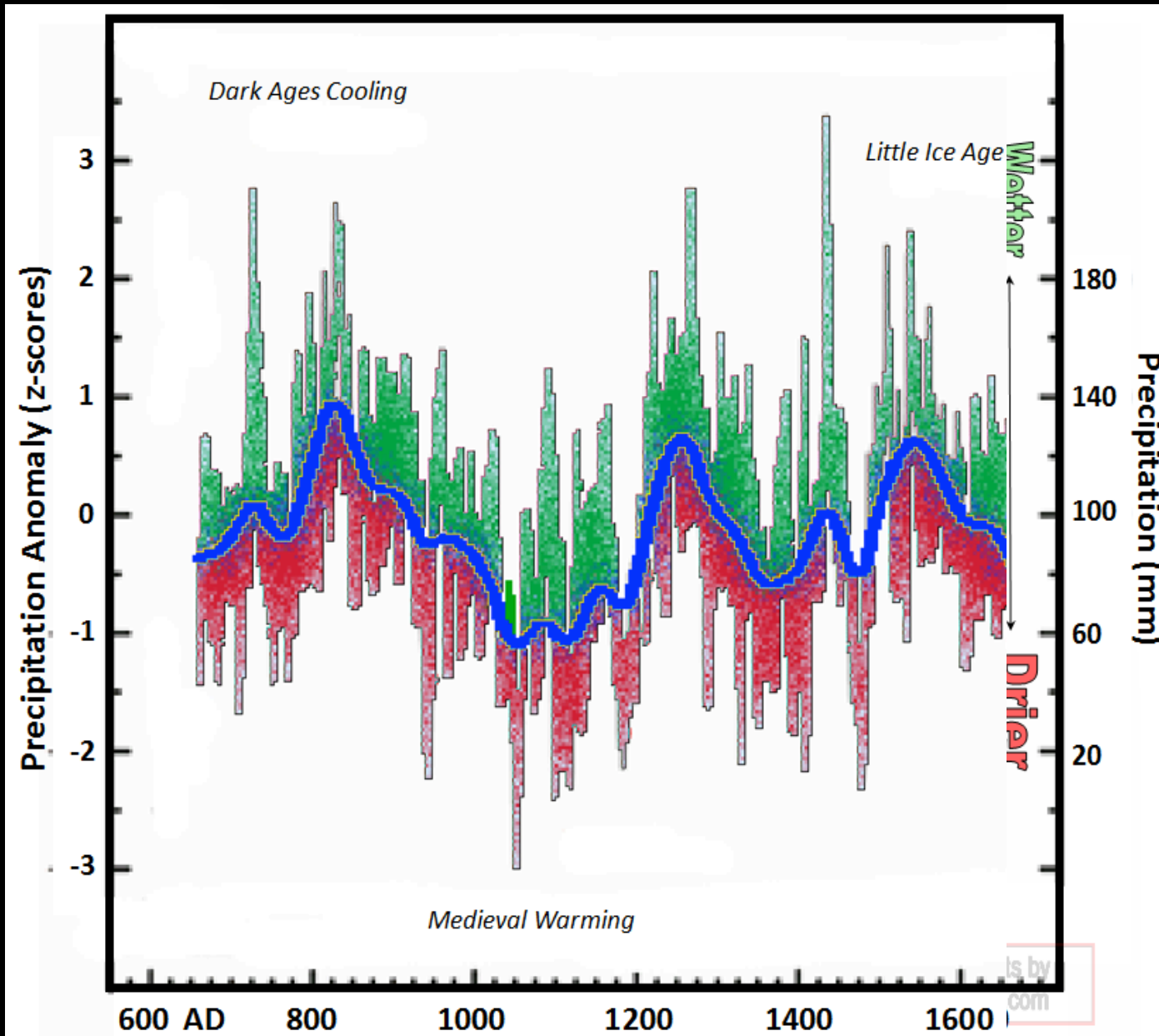
# Temperature Variations From Three Latitude Studies of Alpine Snow Depth



Source: [http://c3headlines.typepad.com/files/christophermonktondiscussionscalculations\\_references-apocalypsecancelled-11-5-062.pdf](http://c3headlines.typepad.com/files/christophermonktondiscussionscalculations_references-apocalypsecancelled-11-5-062.pdf)



# Finland Drought and Flood Record



Source: [http://www.co2science.org/data/mwn/studies13\\_southernfinland.php](http://www.co2science.org/data/mwn/studies13_southernfinland.php)



Pinatubo, Philippines 2003-06  $\pm$  6 million tons of ash





Lakagigar Volcano, Iceland, responsible for much 1759 atmospheric devastation leading to the Little Ice Age

Krisuvik Volcano, Iceland, also erupted in 1340

Chinese historians recorded 5 Indonesian supervolcano eruptions in 14<sup>th</sup> c.

Arctic Ice Pack began advancing southwards across Greenland in late 13<sup>th</sup> to early 14<sup>th</sup> c. .

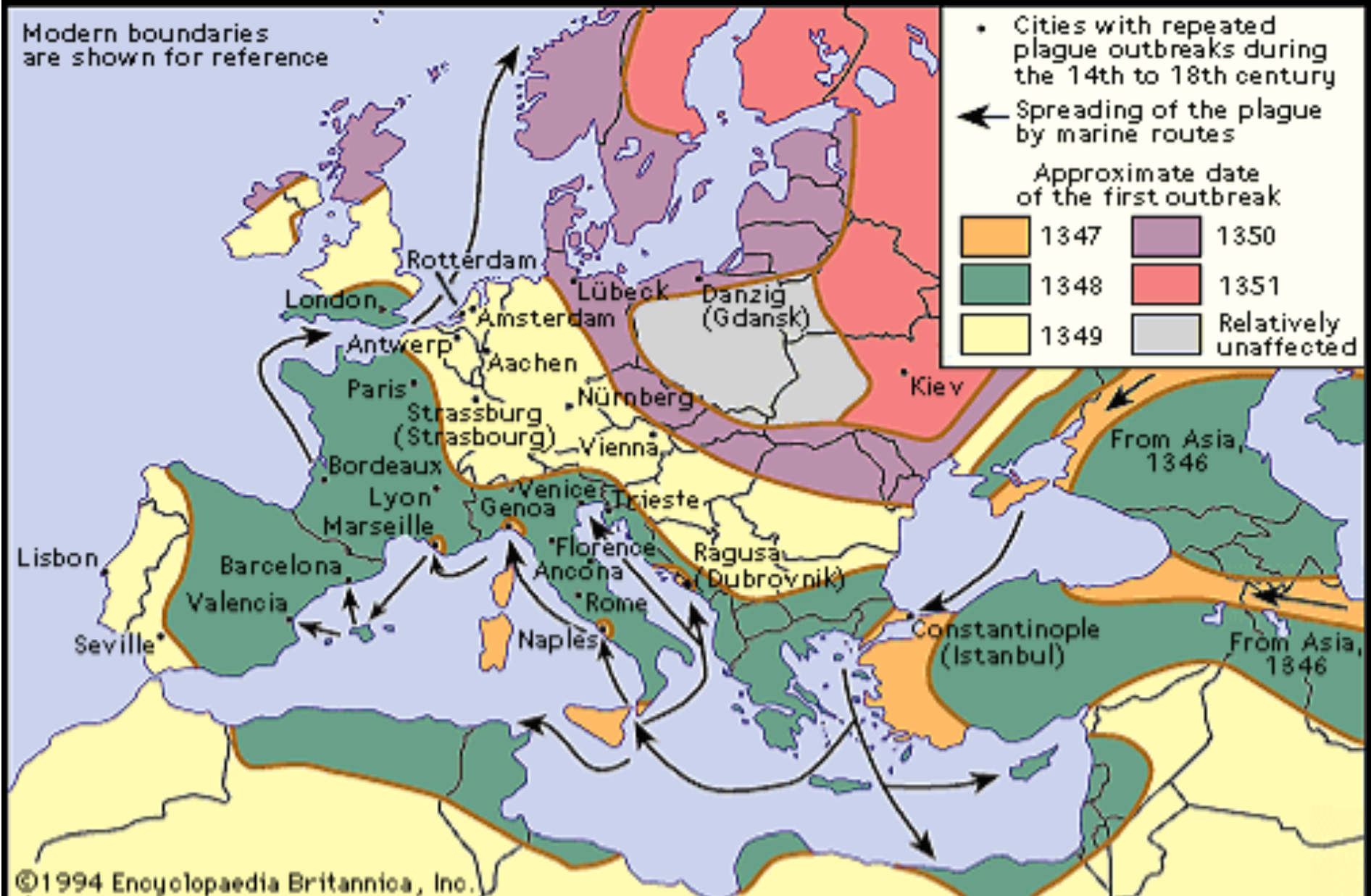




Toggenburg Bible illustration 1411



# Path of Plague between 1347-51



What caused the vector change of a newly mobile disease from east to west? Changing climate?



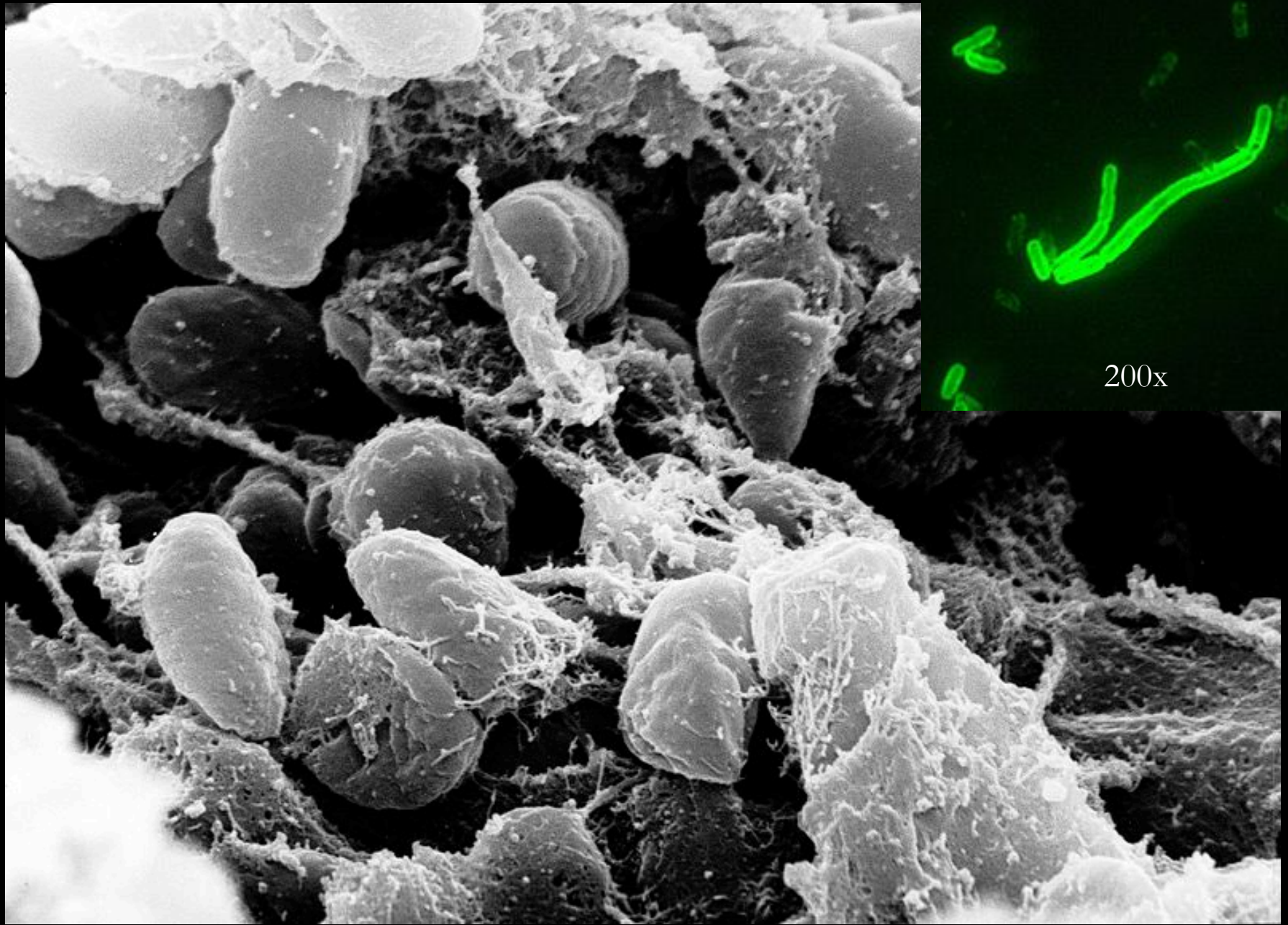
*Rattus rattus*







*Siphonaptera* (flea) plague from enterobic bacteria in the flea on the rat



*Yersinia pestis* 1.50µm

200x





*Three Dead,  
Three Living*  
MS G.14 fol.  
114r,

Late 14<sup>th</sup> c.

J. Pierpont  
Morgan  
Library





*Psalter and Hours of Bonne de Luxembourg,  
Duchess of Normandy, circa 1348*





A distinct lack of sanitation





Burning Jews Alive During Black Death *Liber Chronicarum* 1493



## Leviticus 13

1 “The LORD said to Moses and Aaron, 2 “When anyone has a swelling (*se’êt* שֵׁאֵת) or a rash or a bright spot on his skin that may become a plague (*nega’* נֶגַע) of ‘leprosy’ (*tsar’at* צִרְעָתָה), he must be brought to Aaron the priest or to one of his sons who is a priest. 3 The priest is to **examine** the sore on his skin, and if the hair in the sore has turned white and the sore appears to be more than skin deep, it is an infectious skin disease. When the priest examines him, he shall pronounce him ceremonially unclean. 4 If the spot on his skin is white but does not appear to be more than skin deep and the hair in it has not turned white, the priest is to put the affected person in **isolation** for seven days. 5 On the seventh day the priest is to examine him, and if he sees that the sore is unchanged and has not spread in the skin, he is to keep him in isolation another seven days. 6 On the seventh day the priest is to examine him again, and if the sore has faded and has not spread in the skin, the priest shall pronounce him clean; it is only a rash. The man must wash his clothes, and he will be clean. 7 But if the rash does spread in his skin after he has shown himself to the priest to be pronounced clean, he must appear before the priest again...52 He must **burn up** the clothing, or the woven or knitted material of wool or linen, or any leather article that has the unclean thing in it, because the unclean thing is destructive; the article must be burned up.”

ps vera est quicquid alij dicant.  
nec debeat adu manifestate sequi



*Latin  
Illuminated  
Manuscript from  
France*

Plague-  
stricken  
monks  
being prayed  
for by  
by a bishop

c. 1370 BNP

Apud sabinnu sic diffinit? inueni  
est habitus cuiuscumq; corpus cur





*Bacillus anthracis* lesion



Bubonic plague victim, Morocco 2003





Monastic  
Last Rites

14<sup>th</sup> c.  
French ms





Latin  
Breviary

France

14<sup>th</sup> c.



*Medieval  
Totentanz*







Pieter Bruegel *Triumph of Death* 1562



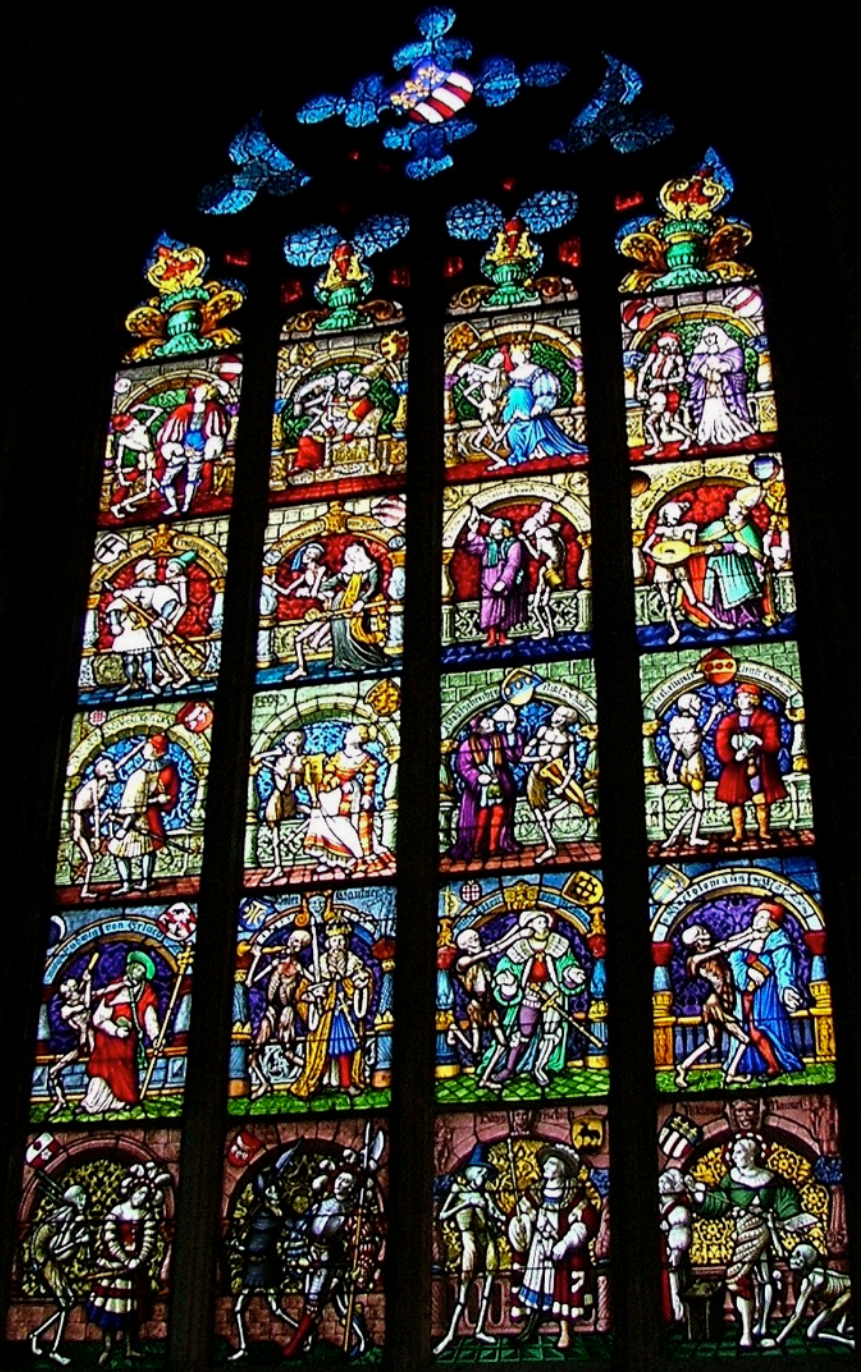






Giacomo Borlone de Buschis *Triumph of Death* 1480 Clusone, Italy





Munster of Bern  
Switzerland, 1441-50











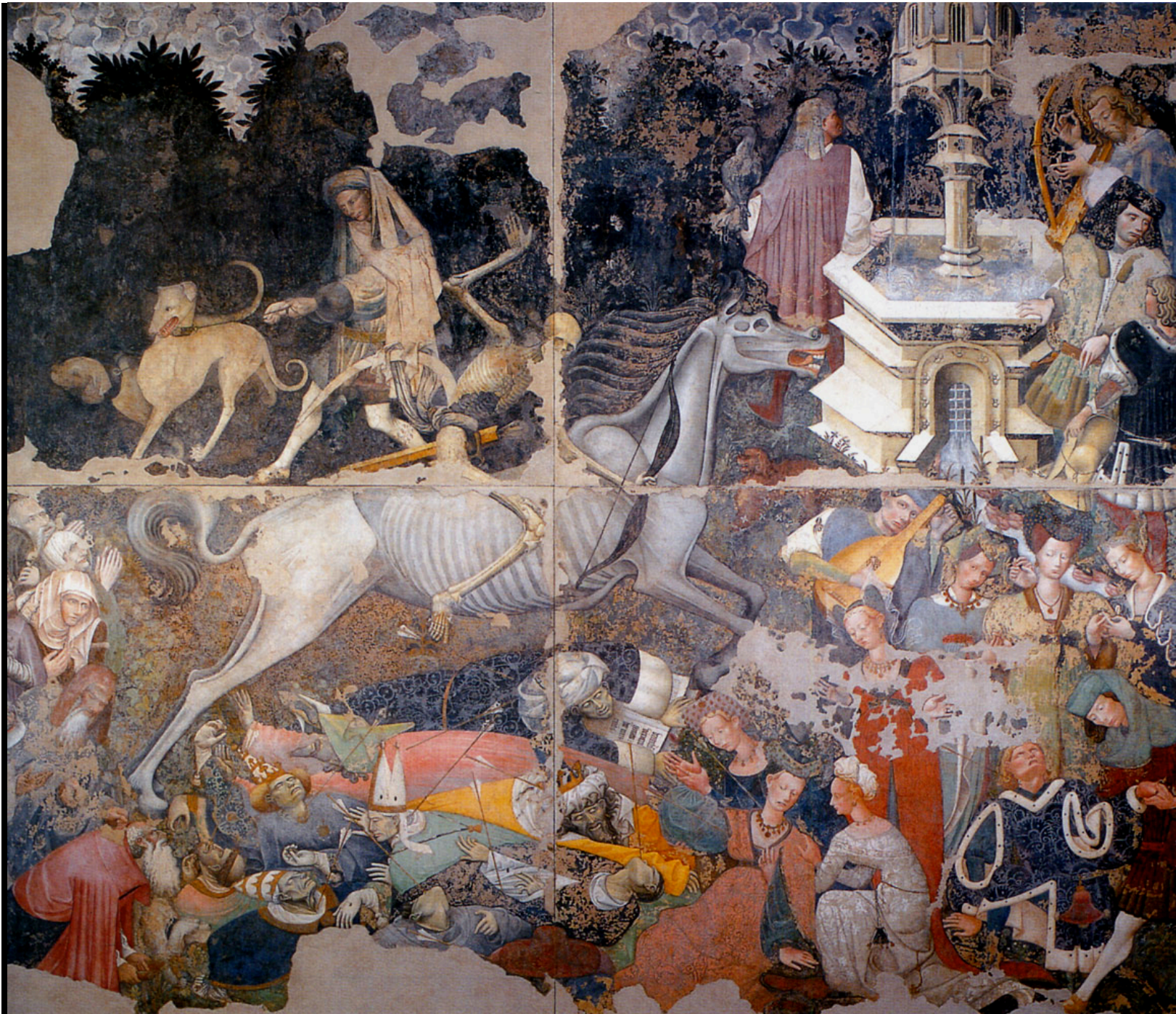


*Triunfo  
Nella  
Morte*

Italy

15<sup>th</sup> c.  
image





*The  
Triumph  
of Death*

Palazzo  
Abatellis

Palermo  
Sicily

c. 1370





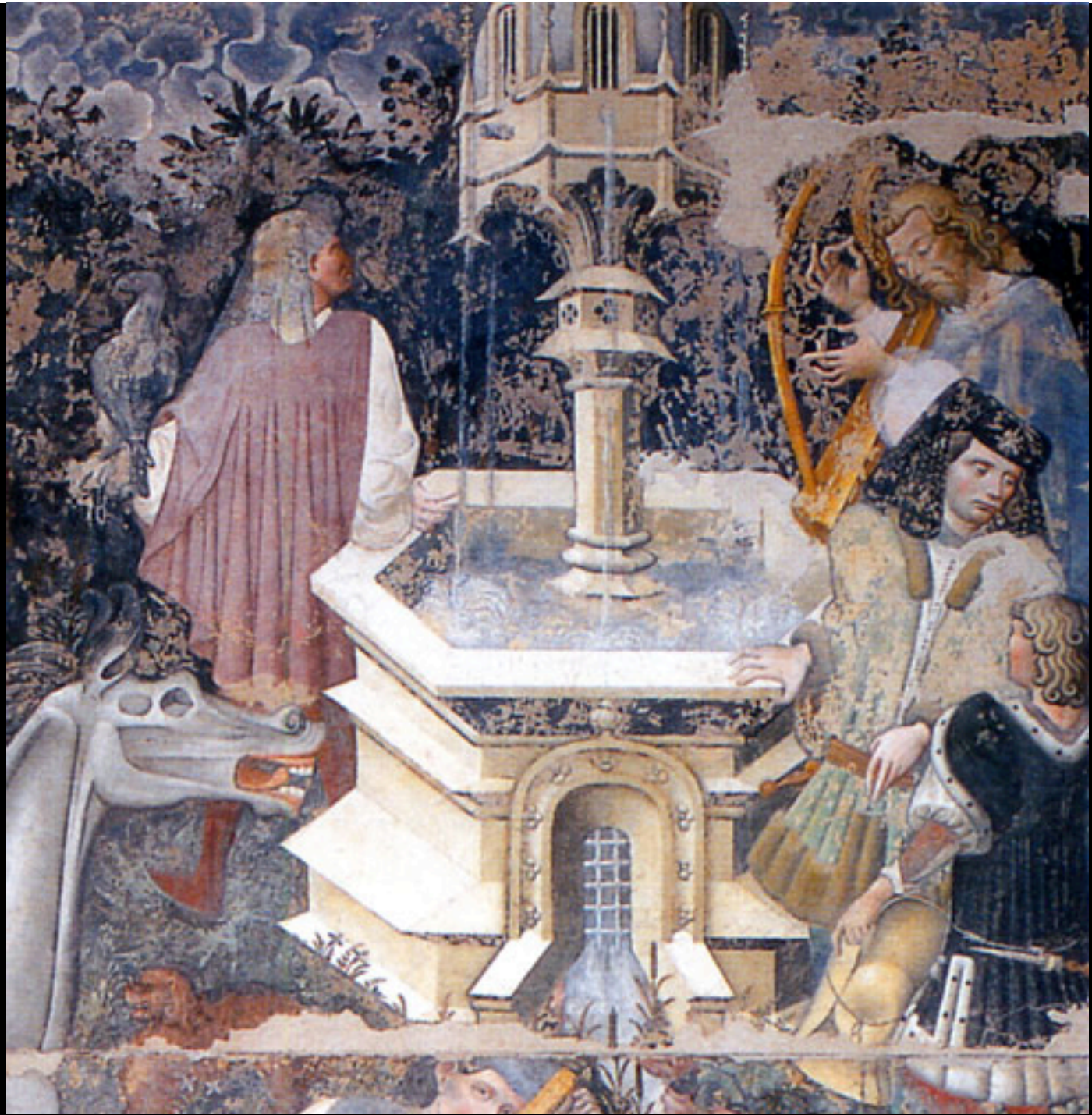


















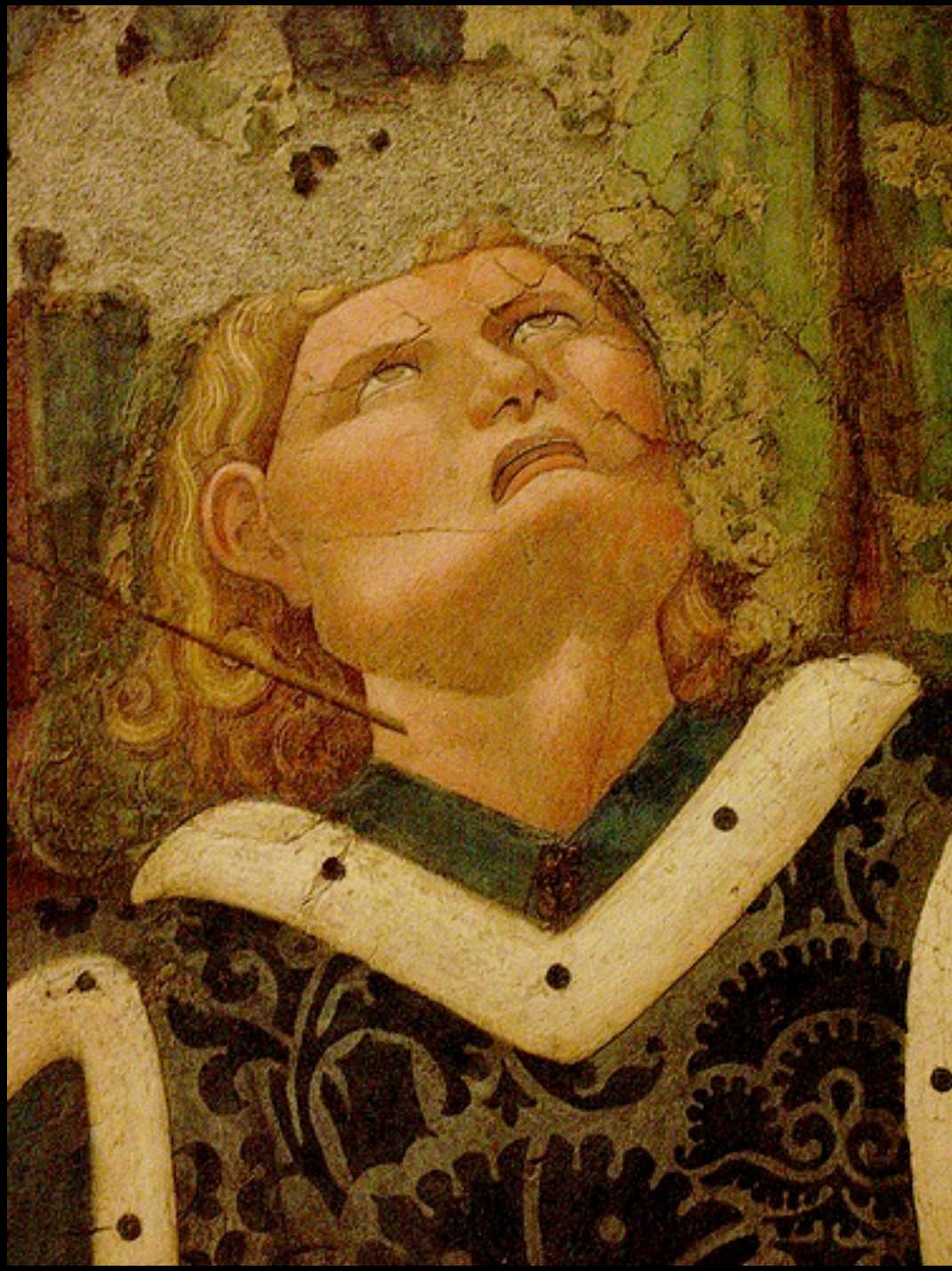




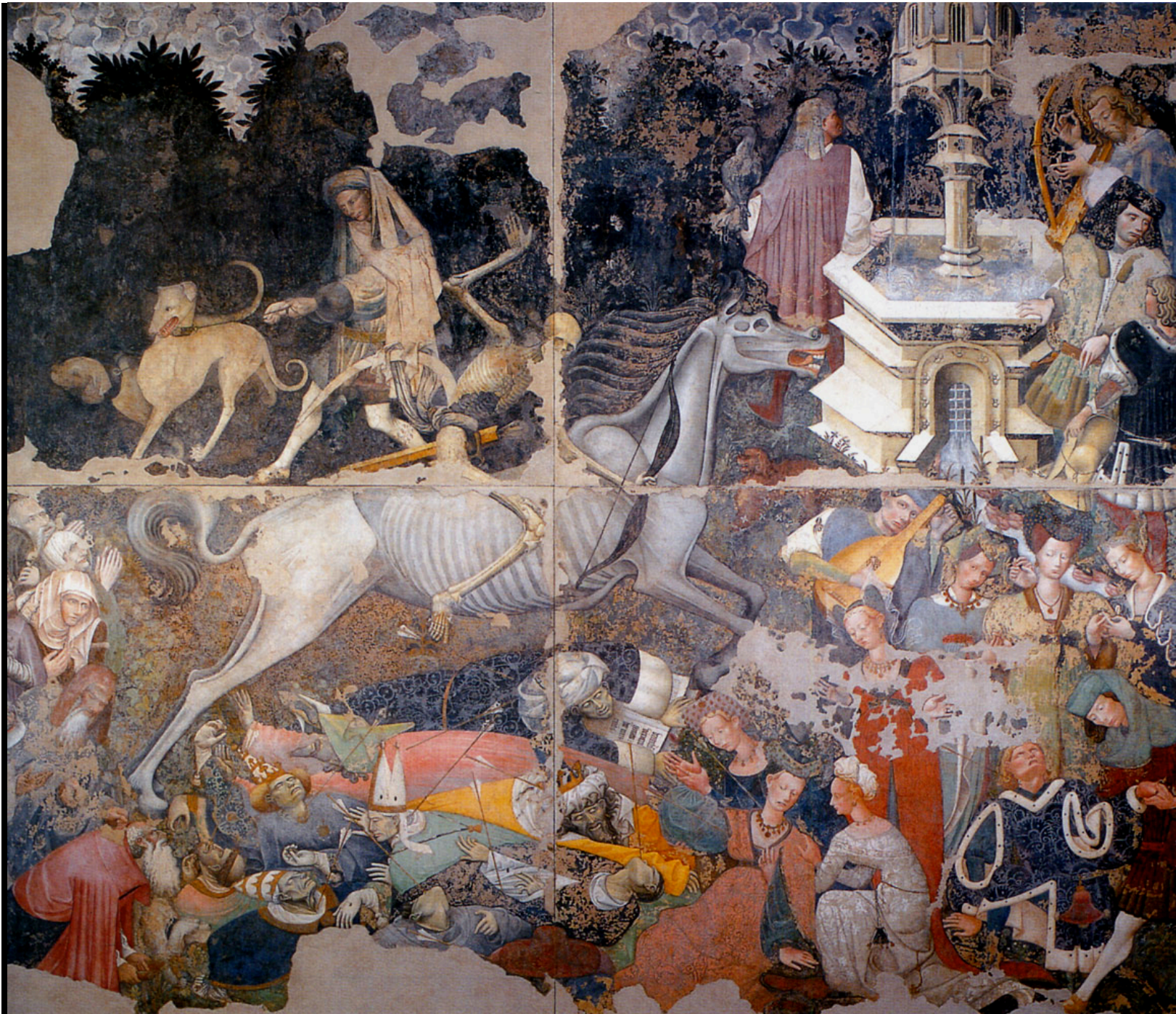












*The  
Triumph  
of Death*

Palazzo  
Abatellis

Palermo  
Sicily

c. 1400

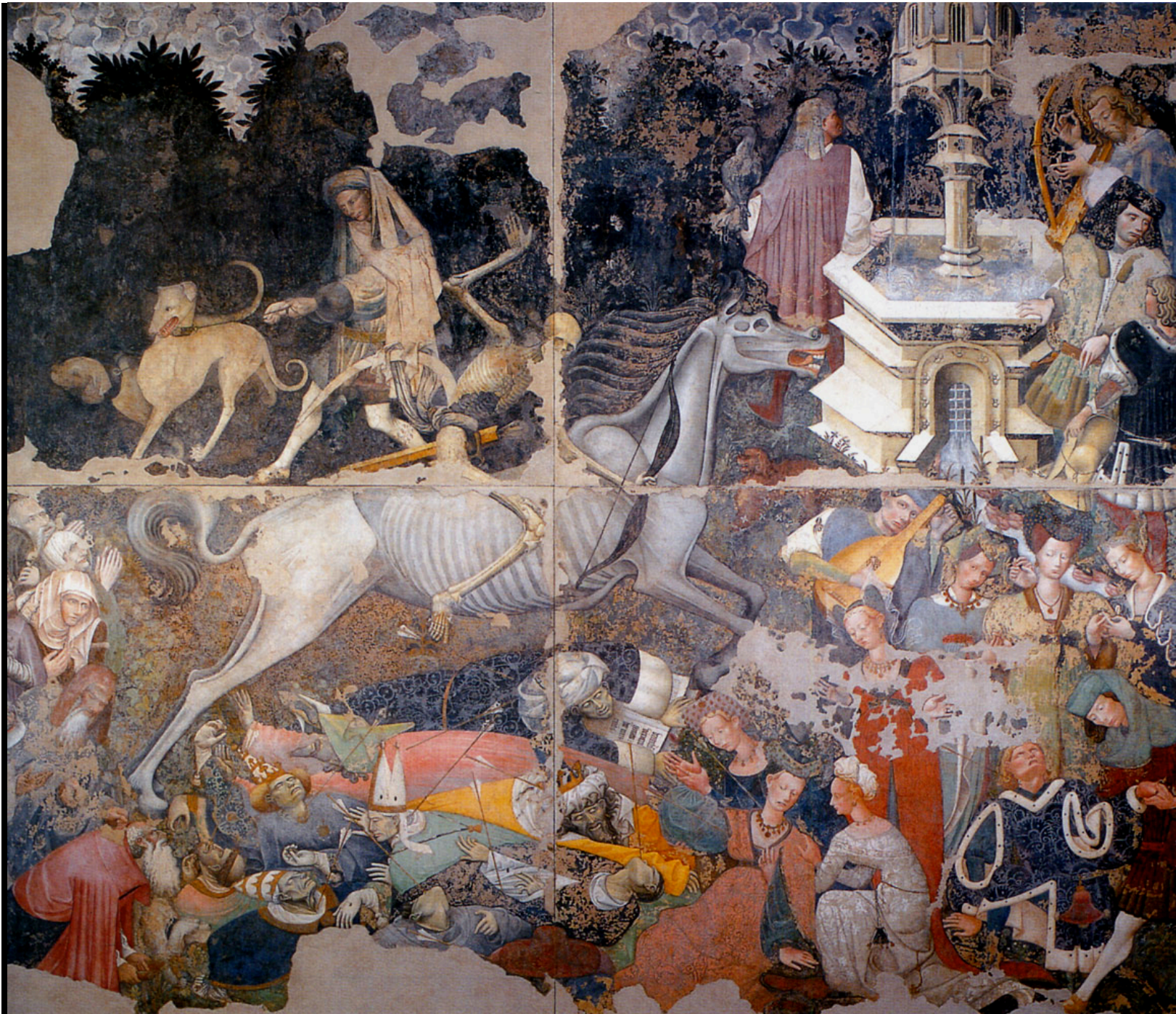












*The  
Triumph  
of Death*

Palazzo  
Abatellis

Palermo  
Sicily

c. 1400





G .A. Canaletto, *View of the Ducal Palace,*  
Venice 1755, Uffizi Florence 51 x 83 cm





Carnival in Venice





What is this Venetian mask about ?





Popular mask's  
macabre origin







Dottore Peste





Dr. Doctor Schnabel von Rom

Sic Creditis, ab uno fabul.  
 quod fridone vnde dicitur sicut  
 loquitur de contagione  
 et adfert se non loqui  
 Cadavera sicut et ad frigen  
 gleich wie der Corvus auf der Alpen.  
 Ah Credite: adit nicht dore ha  
 kann Romis regnat die fipin

Quo non deberet se esse  
 sic seinet Virgileus faden  
 qua loquitur ab wat er sum  
 und dicit seon consilium  
 Et mancher Credit dnas wofel  
 zu im tentit en fhwernatig  
 Marfapum heyt seine Hill  
 und curiam zu jehote fud

Kleidung wider den Tod zu Rom Anno 1656.  
 Also gehen die Doctores Medici dā zu Rom, waren sie die ander Best ertrandte Pa  
 sinnen beschaffen sie zu curiren und fragen sich wider den Tod zu sichern ein langes Kleid von ge  
 roder dem Guch ist Angefichte ist zerlarol, faden Augen haben sie grosse Crystalline Brillen viele  
 Nasen einen langen Schnabel voll mit treuerdenen Breuren, in der Hand welche mit Hand schuber  
 mit vor sich ist eine lange Kuthe und darmit deuten sie mas man thut, und gebrauch soll









Isola di Poveglia, Venice: Lazaretto Vecchio





Mass Grave of 1500 Plague Victims





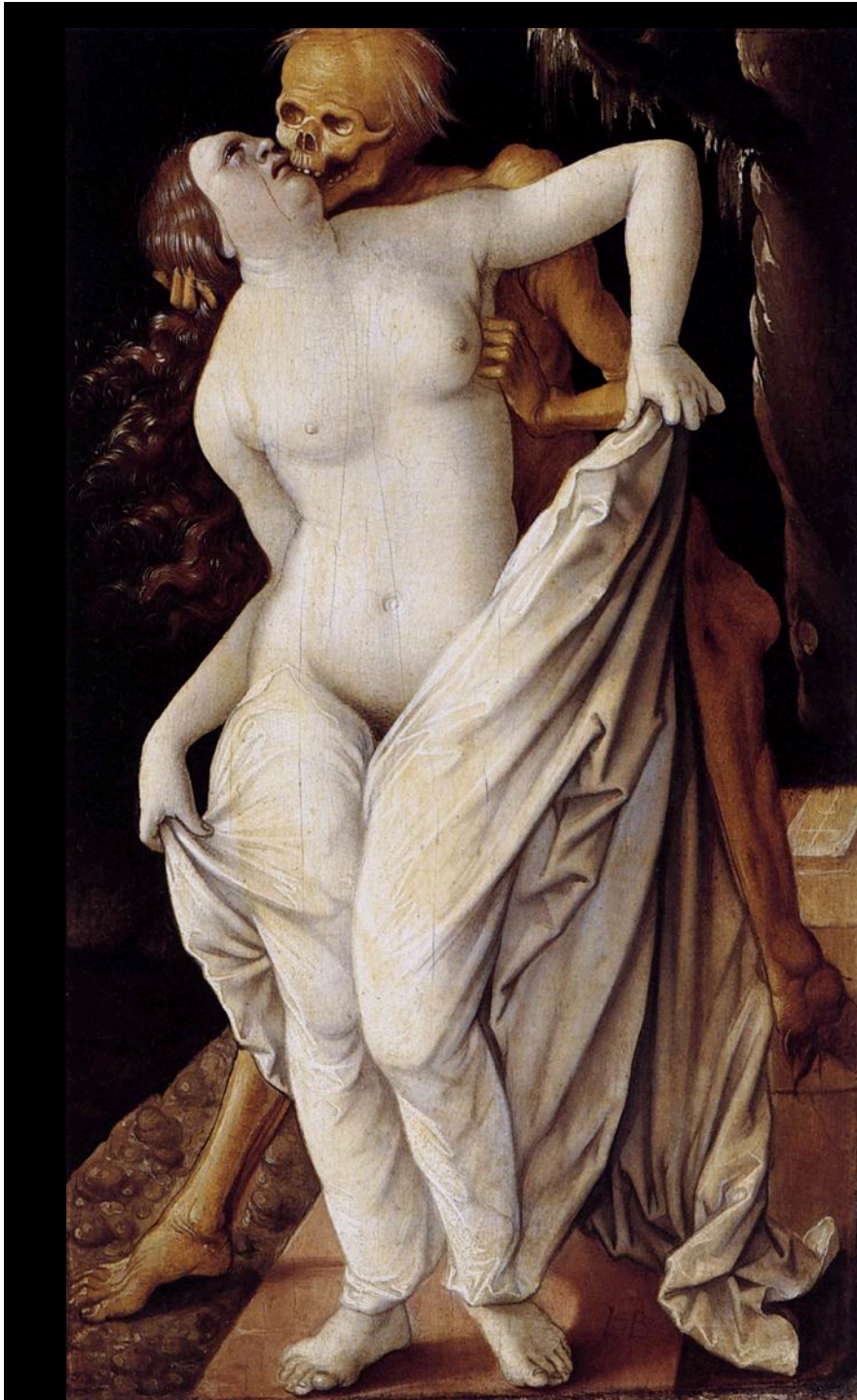
Shroud-eating “vampire”





*The Seventh Seal* Ingmar Bergman, 1957





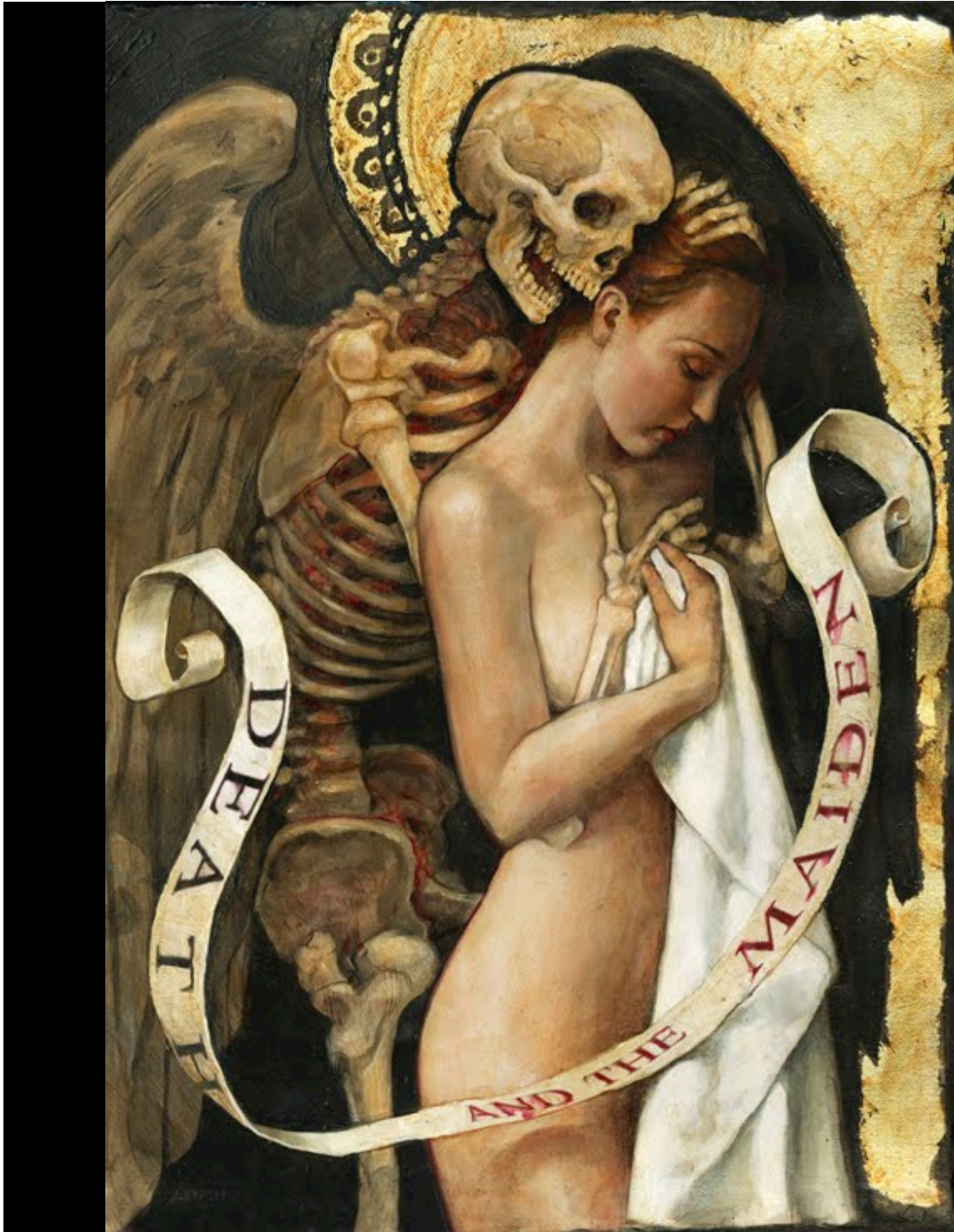
*Death and the Maiden*  
*[Der Tod und das Mädchen]*

c. 1518

Hans Baldung Grien







P. J. Lynch

*Death and the Maiden*

Fall, 2010



A distinct lack of sanitation



*Some Technology Consequences:*

Population loss led to automation  
(e.g., windmills)

*Philosophic consequences:*

Religious skepticism



## *Revelation 6:1-7*

1 "I watched as the Lamb opened the first of the seven seals. Then I heard one of the four living creatures say in a voice like thunder, "Come!" 2 I looked, and there before me was a white horse! Its rider held a bow, and he was given a crown, and he rode out as a conqueror bent on conquest.

3 When the Lamb opened the second seal, I heard the second living creature say, "Come!" 4 Then another horse came out, a fiery red one. Its rider was given power to take peace from the earth and to make men slay each other. To him was given a large sword.

5 When the Lamb opened the third seal, I heard the third living creature say, "Come!" I looked, and there before me was a black horse! Its rider was holding a pair of scales in his hand. 6 Then I heard what sounded like a voice among the four living creatures, saying, "A quart of wheat for a day's wages, and three quarts of barley for a day's wages, and do not damage the oil and the wine!"

7 When the Lamb opened the fourth seal, I heard the voice of the fourth living creature say, "Come!" 8 I looked, and there before me was a pale horse! Its rider was named Death, and Hades was following close behind him. They were given power over a fourth of the earth to kill by sword, famine and plague, and by the wild beasts of the earth."





