

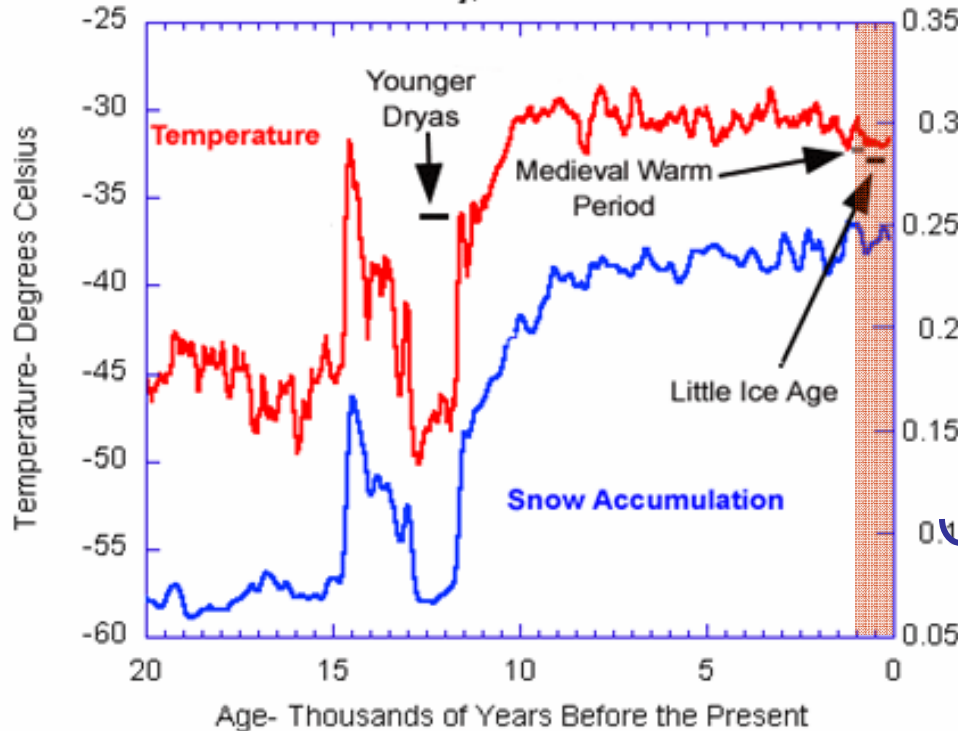
# Case Studies of How Humans and the Environments Have Interacted



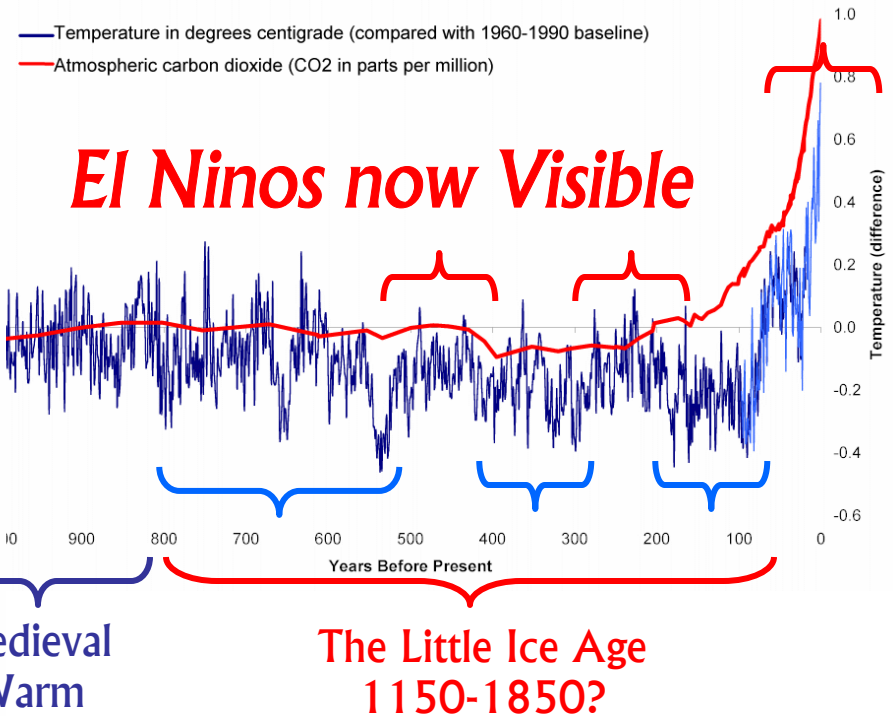
# Fractal Temperature Patterns in Time

## 20,000 Year Record

GISP2 Ice Core Temperature and Accumulation Data  
Alley, R.B. 2000



## 1,000 Year Record



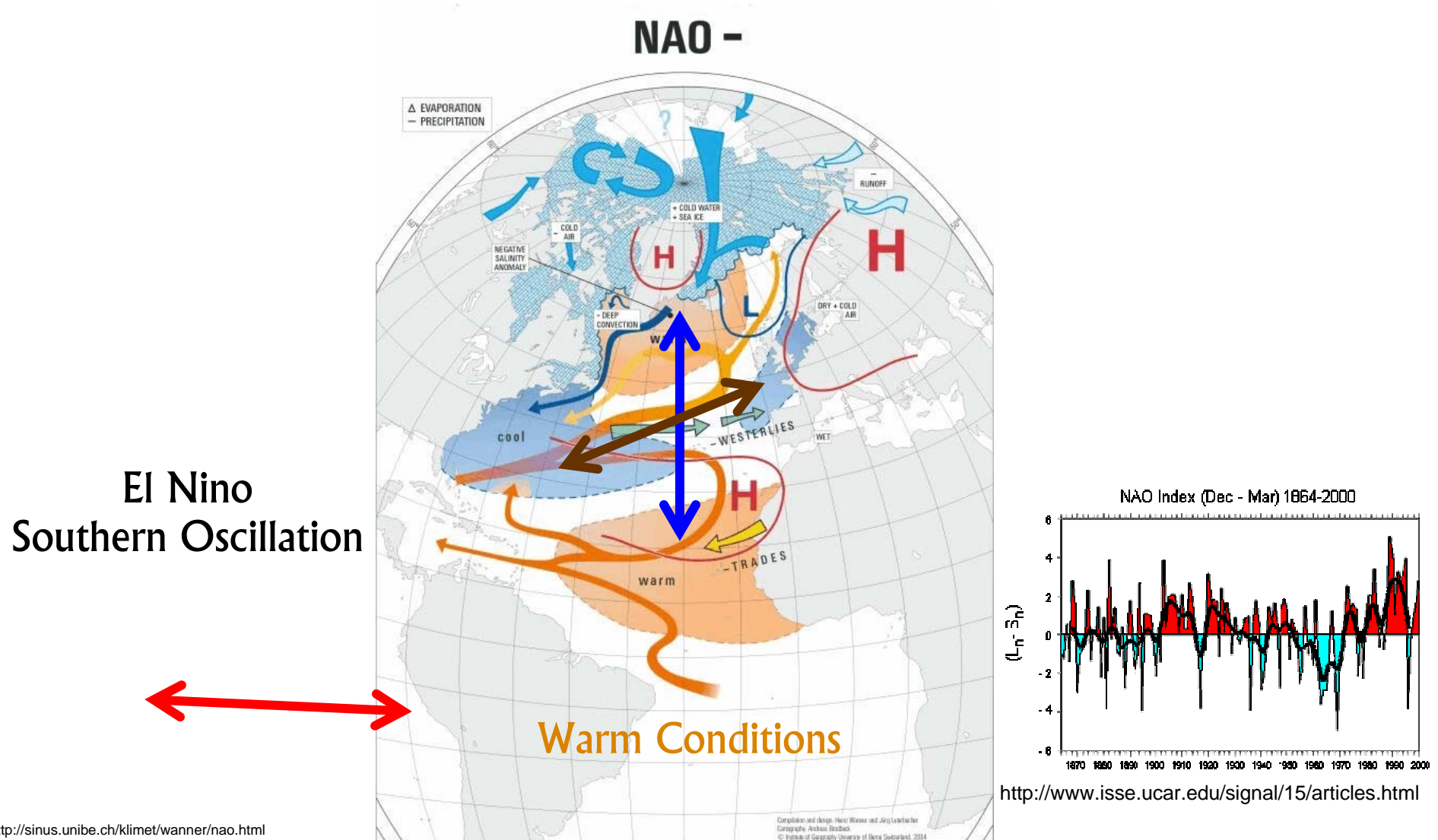
These fluctuations have produced many records of human suffering in the past 1000 years.

# NOA Oscillation

## ENSO La Nina and El Nino Oscillation

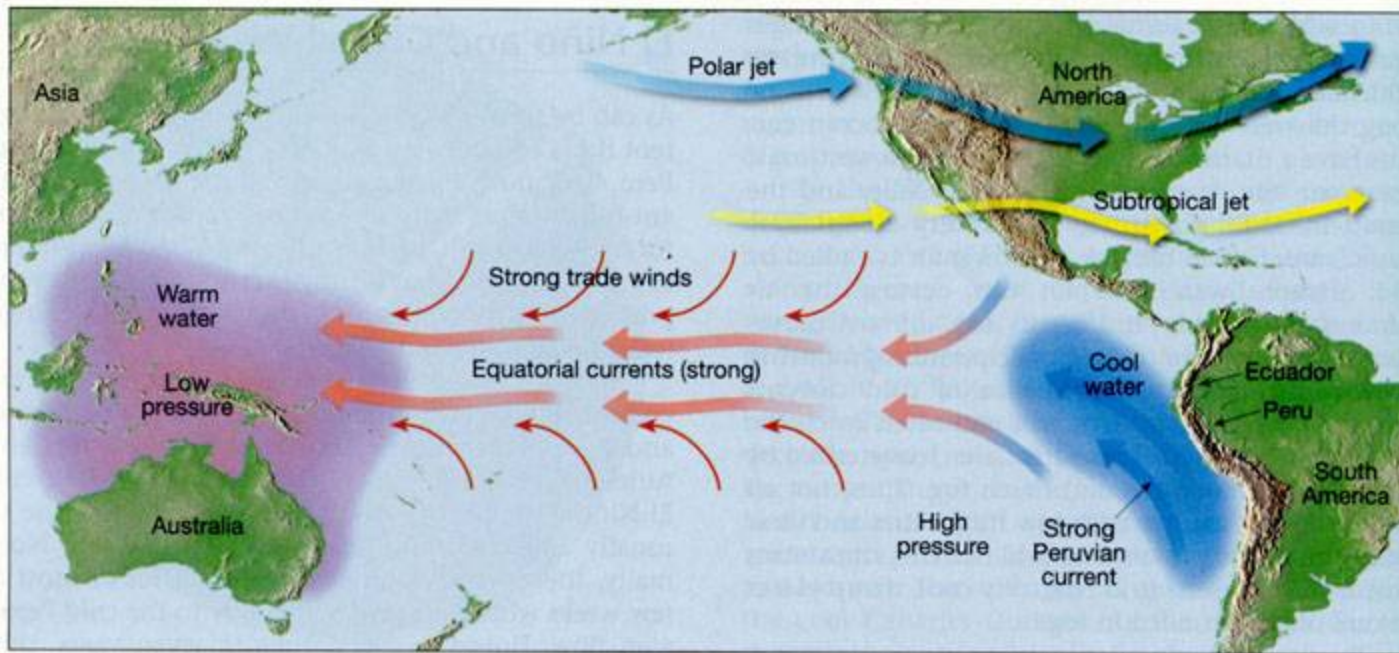
# BISTABLE BEHAVIOR IN RECENT CLIMATE

## The North Atlantic Oscillation Recent Glacial/Interglacial Cycles



# The Southern Oscillation

## El Niño and La Niña



**Fig.6 Normally, the trade winds and strong equatorial currents flow toward the west. At the same time, an intense Peruvian current causes upwelling of cold water along the west coast of South America.**

Near the end of each year as the southern hemispherical summer is about to peak, a weak, warm counter-current flows southward along the coasts of Ecuador and Peru, replacing the cold Peruvian current. Centuries ago the local residents named this annual event El Niño (span. "the child") based on Christian theology that assigned this period of the year the name-giving Christmas season. Normally, these warm countercurrents last for at most a few weeks when they again give way to the cold Peruvian flow. However, every three to seven years, this countercurrent is unusually warm and strong. Accompanying this event is a pool of warm, ocean surface water in the central and eastern Pacific.

El Niño has made frequent appearances over the last century, with particularly severe consequences in 1891, 1925, 1953, 1972, 1982, 1986, 1992, 1993, and 1997.



# The Southern Oscillation

## El Nino and La Nina

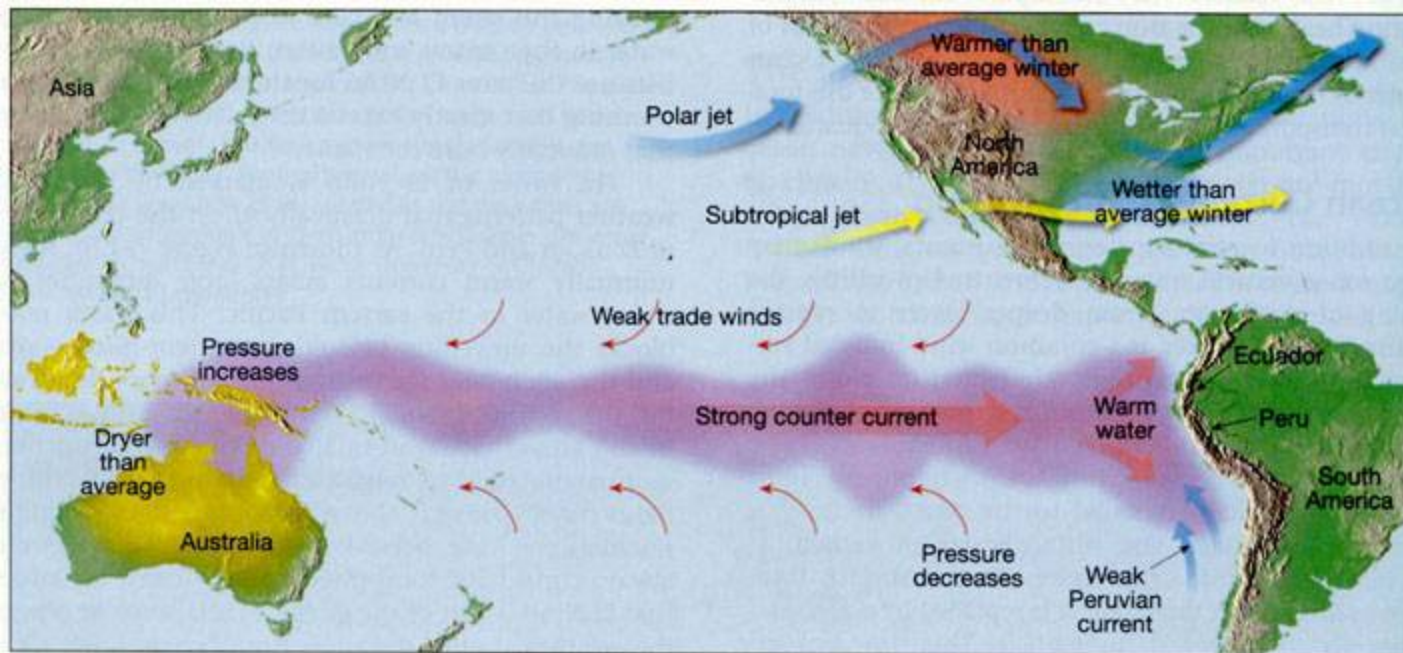
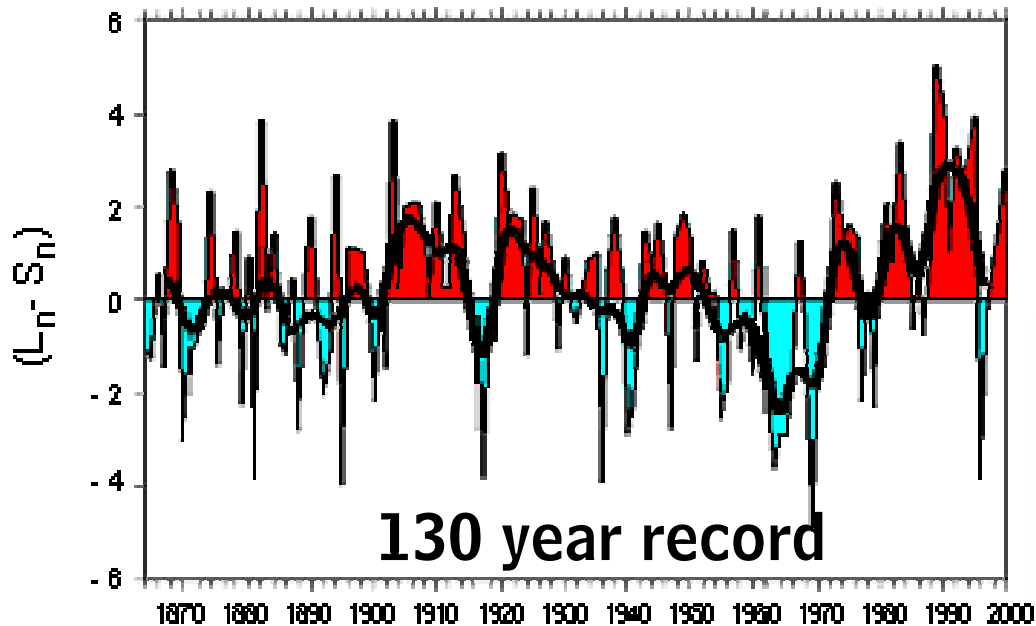


Fig.14 Upon the advent of an ENSO event, the pressure over the eastern and western Pacific flip-flops. This causes the trade winds to diminish, leading to an eastward movement of warm water along the equator. As a result, the surface waters of the central and eastern Pacific warm, with far-reaching consequences to weather patterns.

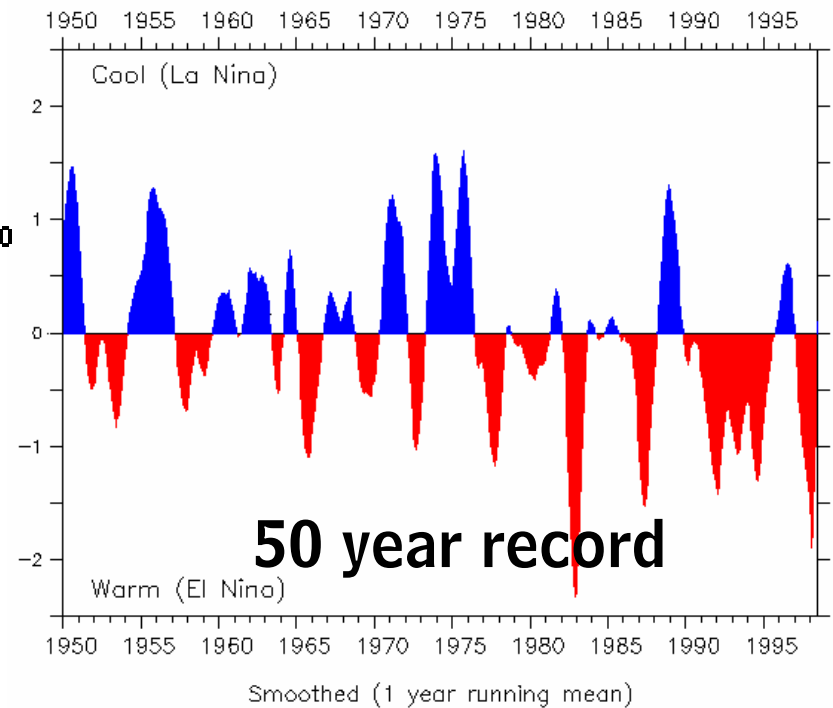
# Bistable Behavior in Recent Climate

## The Southern Oscillation

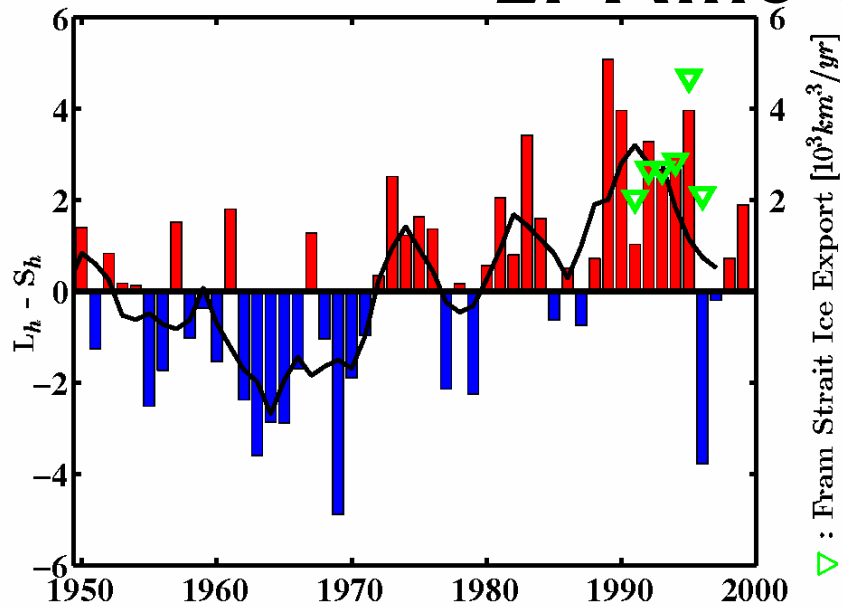
NAO Index (Dec - Mar) 1864-2000



Southern Oscillation Index



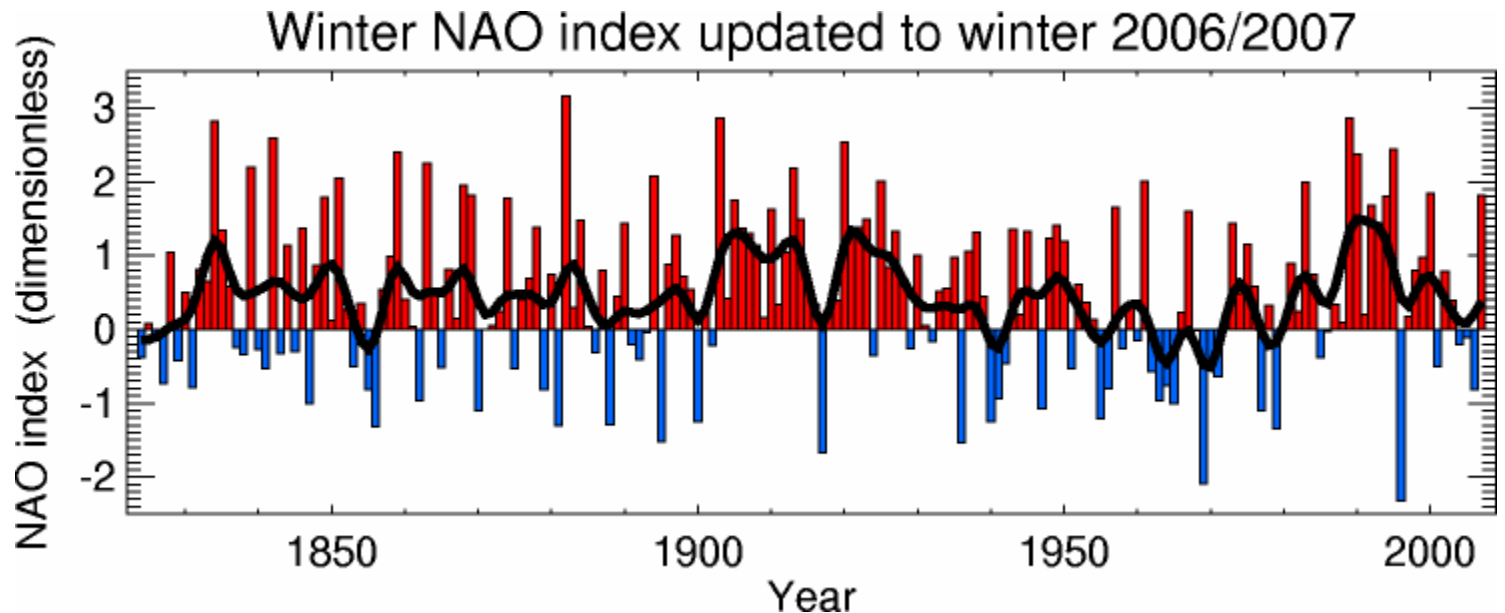
# El Nino and La Nina



Strong El Nino episodes are so rare that relatively few people witness a truly catastrophic incident during their lifetimes.

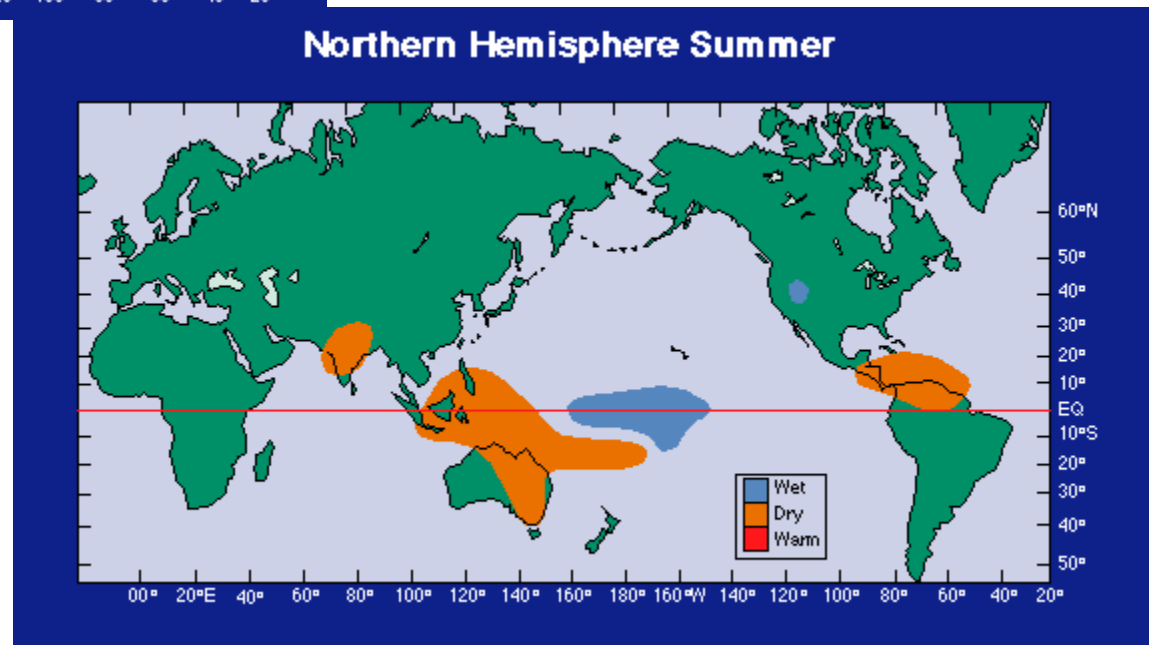
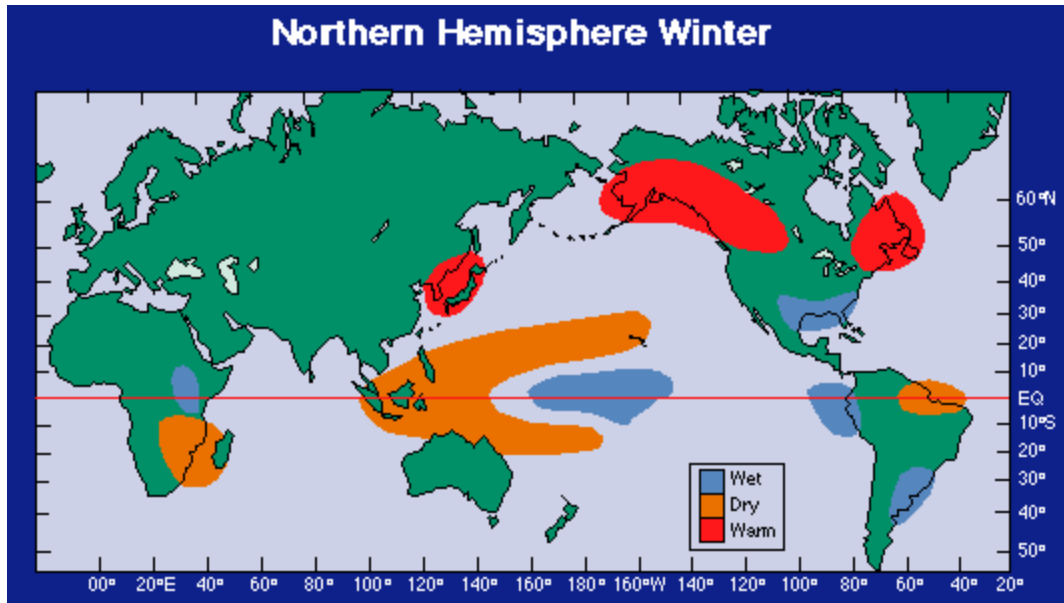
Since climatic events are fractal we expect small ones, within bigger ones, within bigger ones . . .

Some events may show up every few years, others every few hundred years, others every few thousand years.



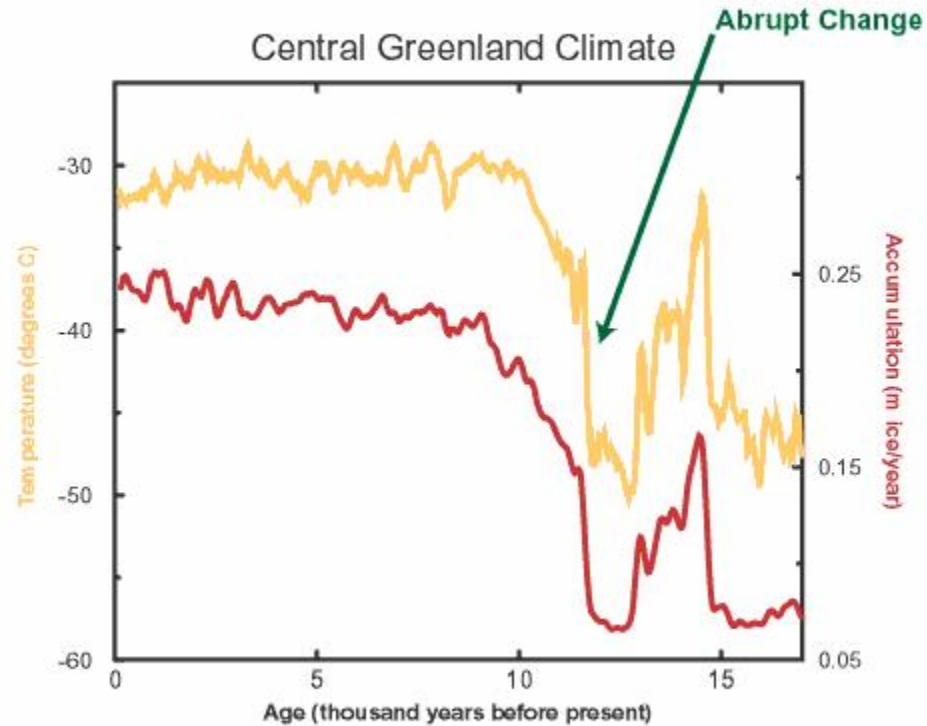


# El Nino and La Nina



# The Younger Dryas

## A Geological Example



# The Moche Lords





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# Moche Map



**Pyramid of the Sun**



# Moche Valley



# Moche Valley



# Moche Civilization



The Moche culture, which flourished on the north coast of Peru between 100 B.C. and A.D. 700, produced one of the most remarkable art styles of Pre-Columbian America. Although the Moche people had no writing system, they left a vivid artistic record of their activities and their environment. Their art illustrates their clothing, architecture, implements, super-natural beings, and a multitude of activities such as warfare, ceremony, and hunting. Although Moche art gives the impression of having an almost infinite variety of subject matter, analysis of a large sample of it has suggested that it is limited to the representation of a small number of specific events, or activities, which are referred to as themes. (Donnan 2004)









# Rise and Demise of the Moche Civilization

The Moche were a highly stratified people made up of rulers, warriors, craftsmen, and farmers. It was one of the largest civilizations in Pre-Columbian America and its people were presumably ruled by a god-king who gained and kept power through human sacrifice. In the end, however, sacrifice wasn't enough to hold back a series of natural disasters that led to the downfall and eventual collapse of the powerful Moche empire.

These numerous natural disasters set the ball rolling for the eventual disappearance of Moche civilization. After the constant environmental changes, faith in the Moche deities was presumably lost and the stratified social structure most certainly crumbled.

The primary enemy of the Moche world was the El Niño. Around 500 AD, the normally temperately cool Humbolt current began to run warm. The change from cool to warm brought heavy rainfall that could have lasted for as long as 18 months. The mud brick huacas (ceremonial temples) were not only partially eroded, but the hard mud walls began to "melt" together from the flooding. Evidence shows that 15 feet or more of some adobe structures had been taken away by either the rain or the flooding it caused.

At the time El Nino struck, the Moche had built miles and miles of canals only to be destroyed by flooding and erosion-devastating their agriculture. Flooding causing dramatic changes in water courses could also trigger massive alteration to the canal systems again decreasing their effectiveness.

While the storm was wreaking its own havoc, earthquakes pushed the shoreline upward, creating a new beach where there once was nothing. Earthquakes rocked the land at various times just as they do now. Shifting earth pushed canals upward destroying the normal flow. This required periodic construction projects on a massive scale to revamp canal systems.

When the Humbolt current returned to normal and the arid conditions once again prevailed, massive sand dunes were blown inward. By 600 AD, all existing man made structures were buried except for the two huge pyramids. Huaca del Sol (above left) is the largest adobe structure in Northern America. Next to it Huaca de Lunastands half buried beneath the dunes that drove the Moche out.

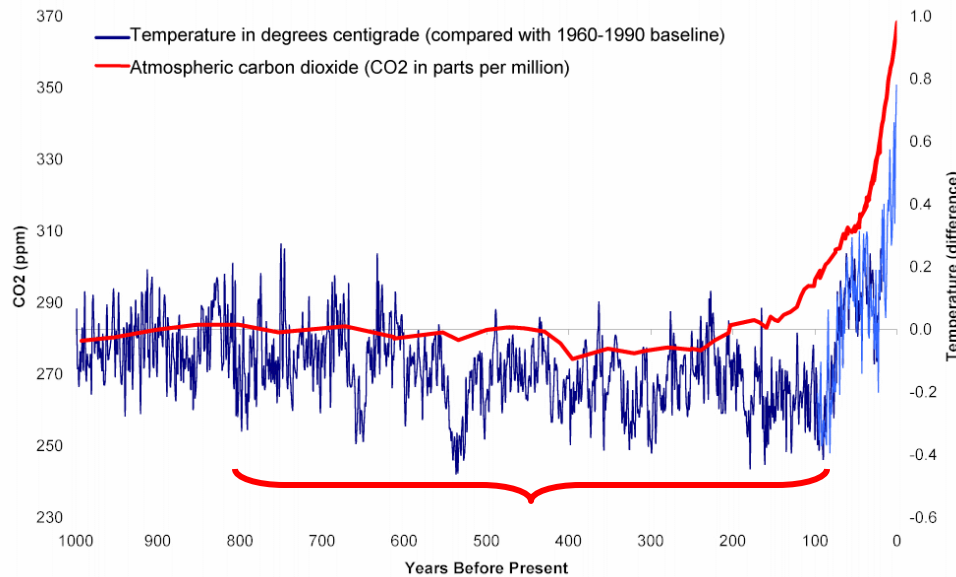
# The Little Ice Age

# Bistable Behavior in Recent Climate

## The Little Ice Age

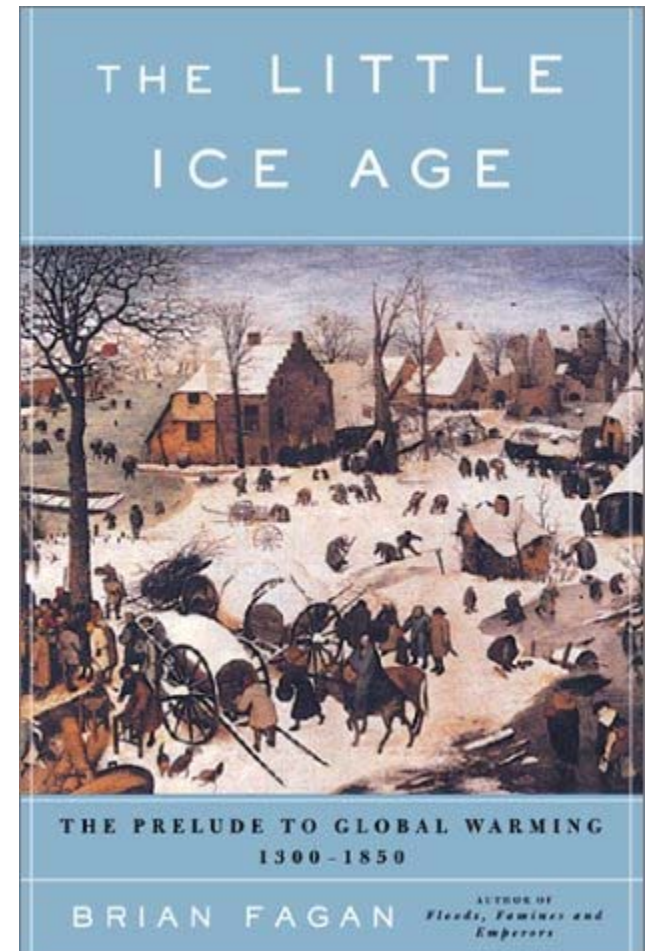
## Recent Glacial/Interglacial Cycles

### 1000 Year Record



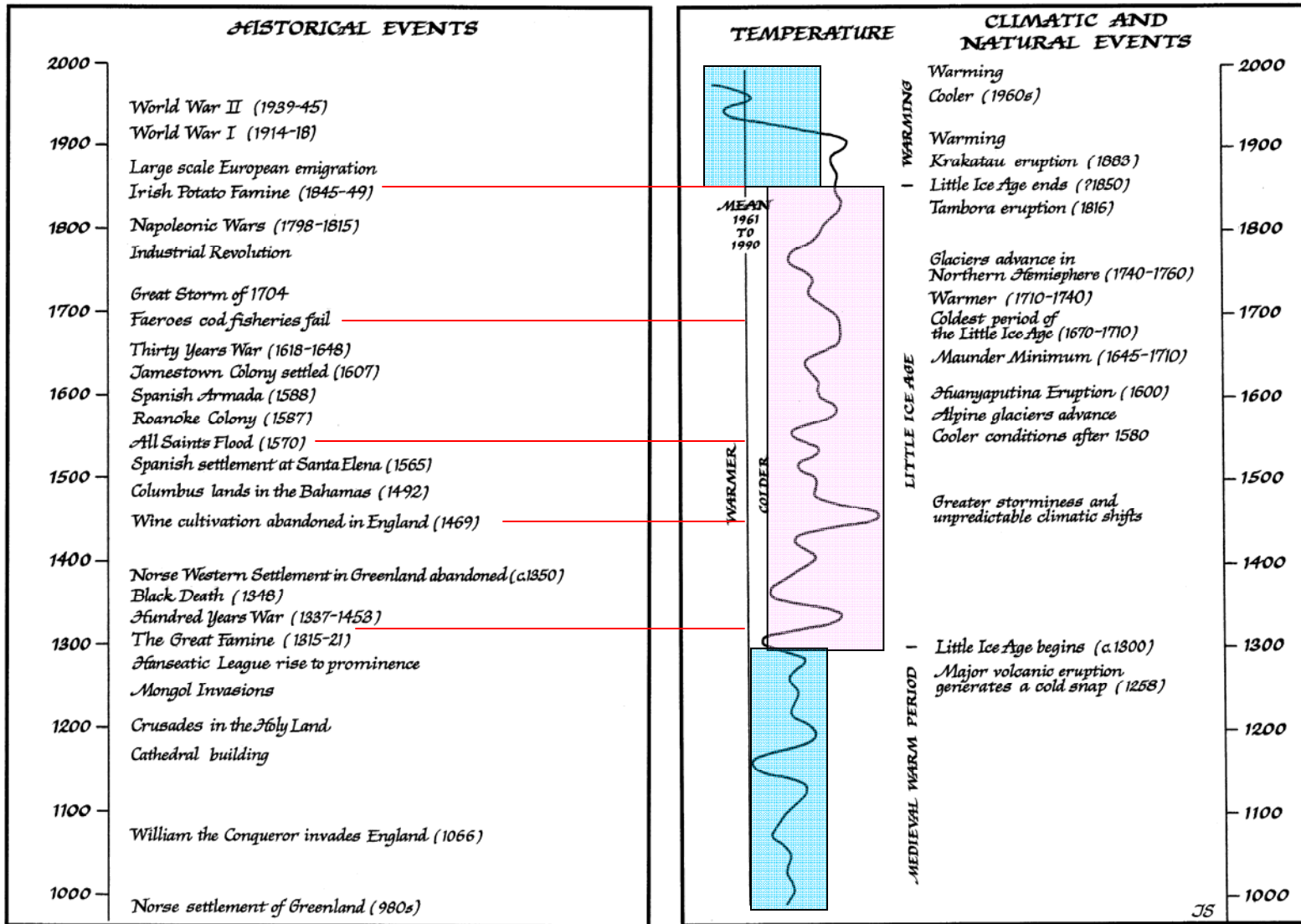
**The Little Ice Age  
1150-1859?**

"Climate change is the ignored player on the historical stage, but it shouldn't be, not if we know what's good for us. We can't judge what future climate change will mean unless we know something about its effects in the past: "those who do not learn from history are doomed to repeat it."

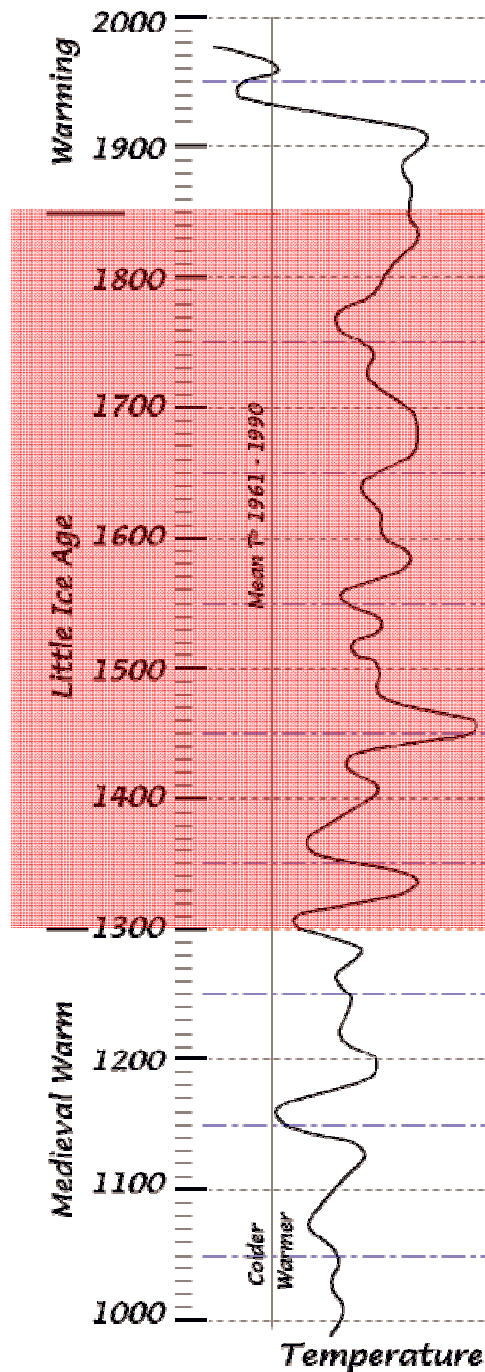


# Bistable Behavior in Recent Climate

## The North Atlantic Oscillation







The Little Ice Age was not a time of unrelenting bad weather, but a time beset by extremes.

There were decades when weather was calm, and times were good.

But, there were bad times of awesomely severe storms, long bitter cold winters, years of drought, and years of sogging rain. All of which ruined crops and led to famine.

It is not the severity of the times that is important here, but the ability of the culture to respond.

But much of the Little Ice Age also corresponded with the price revolution of the 17<sup>th</sup> century.

# The Price Revolution of the Sixteenth Century

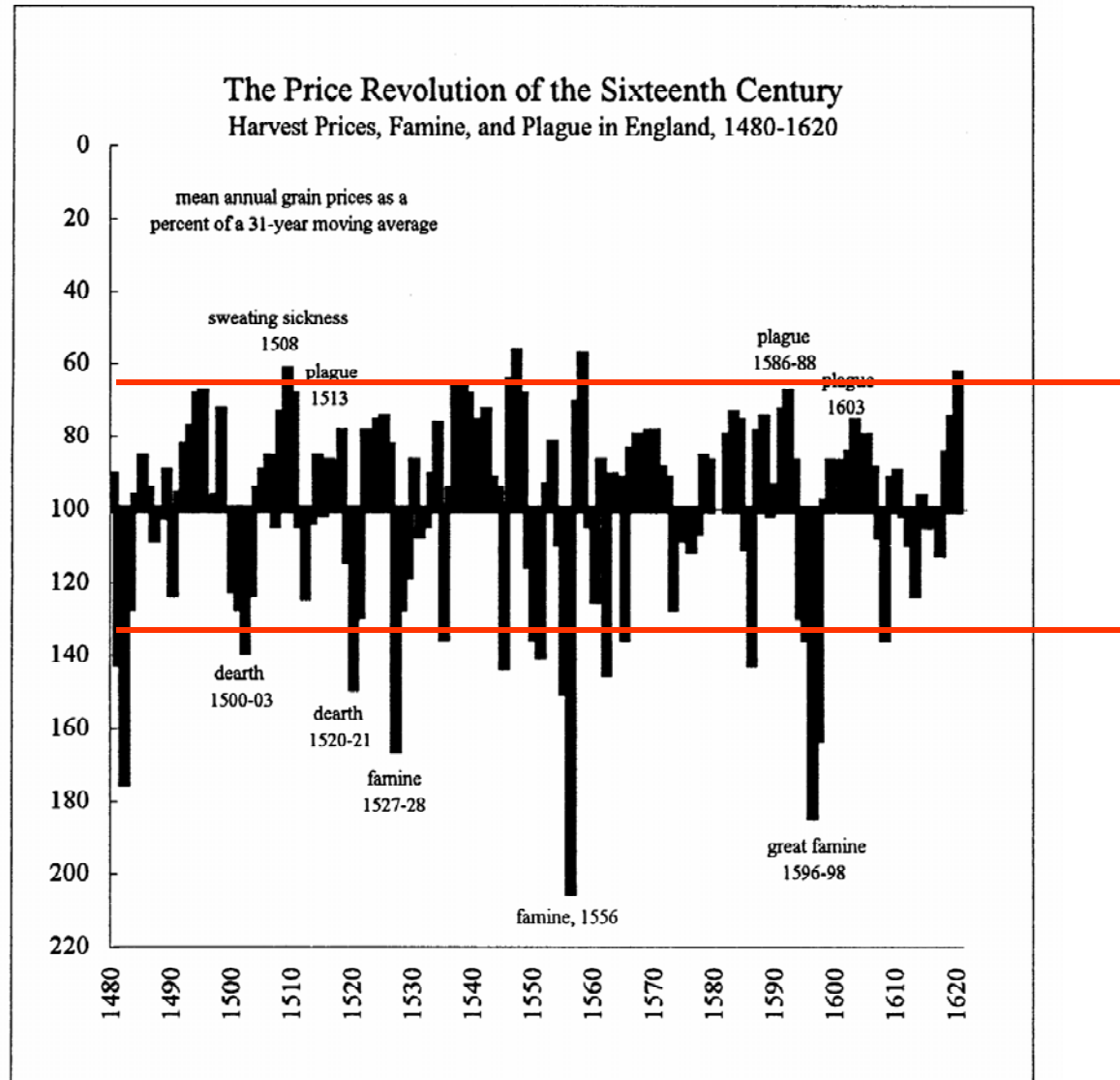


Figure 2.12 compares wheat prices with major famines and plagues in England. The sources are the Bowden series of wheat prices in England, in W. G. Hoskins, *The Age of Plunder* (London, 1976), 87, 246-47; and Andrew Appleby, *Famine in Tudor and Stuart England* (Stanford, 1978), 95-154.

## The Crisis of the Seventeenth Century

Two complex systems, one climatic the other economic, both building toward a tipping point at the same time.

We want to examine how two cultures responded to these situations: Great Britain and France.

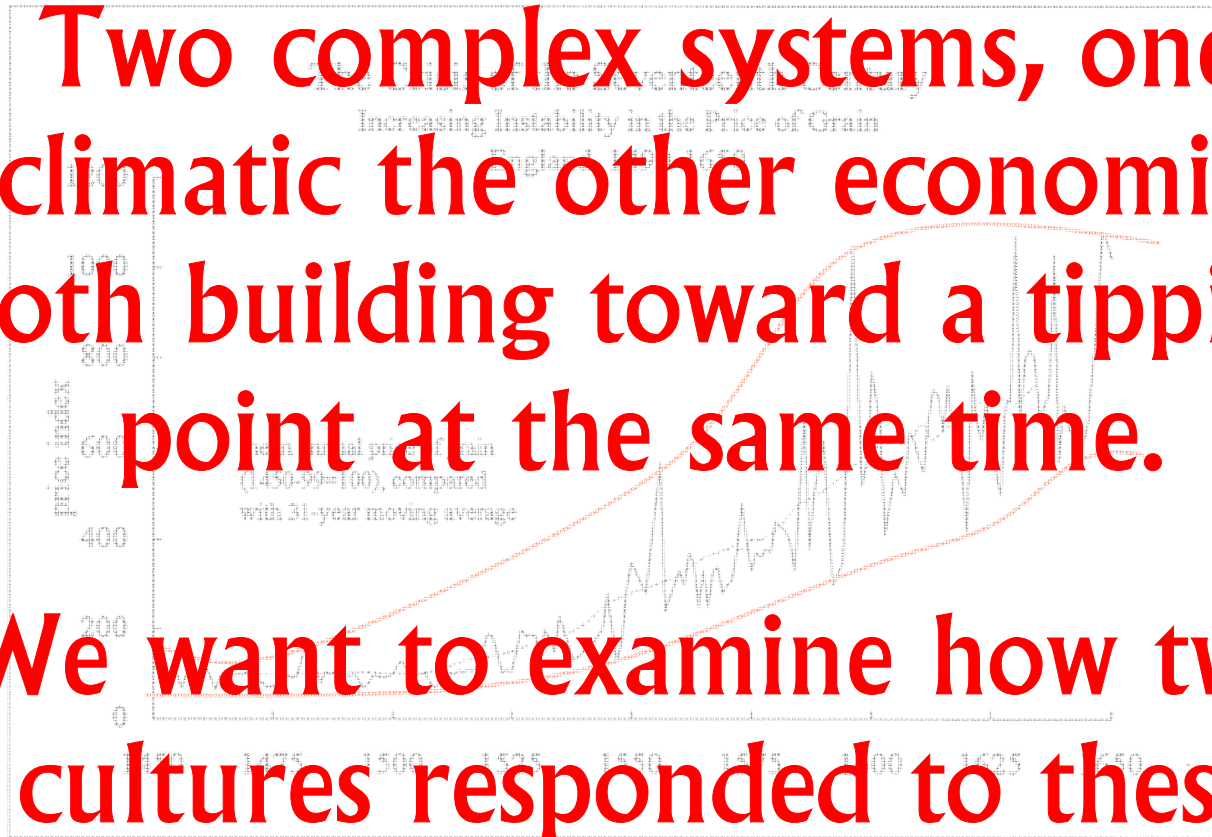


Figure 2.14 shows that harvest prices became more dangerously volatile as the price revolution unfolded in the early modern era. The graph shows average annual prices of wheat in England from 1450 to 1650, compared with a 31-year moving average. The source is G. P. Maddison, "Grain Price Analysis and Harvest Qualities, 1465-1634," *Agricultural History Review* 19 (1971) 135-55, building on W. G. Hoskins, "Harvest Fluctuations and English Economic History, 1480-1619," *ibid.*, 12 (1964) 28-46; and "Harvest Fluctuations and English Economic History, 1620-1759," *ibid.*, 16 (1968) 15-31; and P. Bowden, "Statistical Appendix," in Joan Thirsk, ed., *The Agrarian History of England and Wales*, IV, 814-70.

**Great Britain, the  
English Civil War  
(The Glorious Revolution)  
and Its Consequences**

For a culture where the population was maxed out, and the vast peasantry generally had enough food and seed to get through one year only . . .



. . . after a crop failure, the second year meant starvation, and the third death – if disease did not get you first.



For millennia the diet of western civilization was based on bread made from grain – it had always been that way.



Most European farmers practiced subsistence agriculture familiar to their ancestors since long before medieval times. <sup>106</sup>



Slowly and steadily, during the Little Ice Age as they battled unpredictable and more stormy climates, anonymous British farmers began to experiment with new agricultural methods. <sup>106</sup>

But, the English were not the first to innovate. A low technology agricultural revolution had begun in Flanders and the Netherlands a century before.



More manure, meat, wool, and leather came onto the markets as the new agriculture broke the vicious cycle of overdependence on grain. . . Farmers specialized away from subsistence farming. <sup>106</sup>

By 1600, the influence of Holland and Flanders was already felt around London, where market gardens grew “cabbages, colleflours, turnips, carrots, parsinps and peas.” <sup>108</sup>

The changes came above all from self-improvement, from individual landowners adapting to cooler weather, more difficult farming conditions, and opportunities of the marketplace. <sup>108</sup>



In Daniel Defoe's words, Britain became "a corn country" where widespread famine was unknown. Intensive production and crop diversification guarded against poor grain harvests. . . . Food prices moves over a less extreme range <sup>108</sup>

In 1570 a Spaniard brought back the first potato, and although it was at first felt fit only for fodder, in time it became a staple in everyone's diet. <sup>108</sup>



By 1650 most peasants understood that enclosure was the only way they could break out of the subsistence farmers vicious circle of living from harvest to harvest. <sup>110</sup>



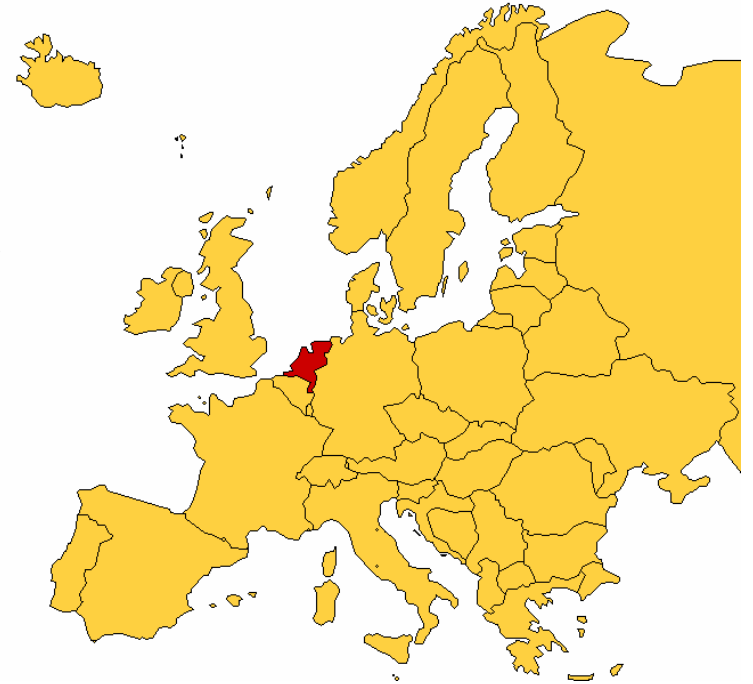
Communal agriculture was not the answer, because the land could yield little more without proper drainage and manuring. . . . The new circle of drainage, soil preparation, stock, and crops could double productivity. <sup>110</sup>

From 1660 onwards, enclosure proceeded briskly, much of it by communal agreement and negotiation. . . . The inexorable forces of economic progress, increasingly colder climate, and history were against the small landowner with little capital and farmers with ill-defined rights to their land. <sup>110</sup>

A lot of the changes in Great Britain came about because of political changes.

England and the Netherlands were connected by related families of the nobility.

For example, Queen Mary II was daughter of King James II of England, and the wife of William of Orange, Stadtholder of the main provinces of the Dutch Republic, who became William the III – King of England.





# English Civil War and Glorious Revolution



1600 - 1649

After King Charles I was executed in 1649, Oliver Cromwell and then his son Richard ruled.



1599 - 1658



1626 - 1712

# English Civil War and Glorious Revolution

But Richard was unfit and in 1660, Britons welcomed Charles II back from exile.

Soon Parliament and the king are at odds again. Charles II didn't oppose Parliament openly but worked behind the scenes.



During his three-year reign, King James II became directly involved in the political battles in England between Catholicism and Protestantism on the one hand, and on the other, between the divine right of the Crown and the political rights of Parliament.

# English Civil War and Glorious Revolution

In 1686, a group of conspirators met at Charborough House in Dorset to plan to depose James and replace him with his daughter Mary and her husband, William Henry of Orange — both Protestants and both grandchildren of Charles I of England.



William and Mary laid careful plans over a number of months for an invasion.

In August, it became clear that William had surprisingly strong support within the English army, a situation brought about by James himself.

In the night of December 9-December 10, the Queen and the Prince of Wales fled for France.



The English call the rebellion of 1688 the Glorious Revolution because there was a major change of government effected without bloodshed. James fled England without a fight. Parliament called in William, the ruler of Holland, and made him king. Parliament was now firmly in command of English politics. William agreed to religious toleration and to Parliament's claims to authority.

In 1689, William and Mary agreed to a Declaration of Rights that guaranteed basic freedom to British subjects to petition the king and to bear arms. It also prohibited excessive fines and cruel and unusual punishment.







The result of the Glorious revolution and William signing the Declaration of rights is that by the mid-eighteenth century, Britain was no longer a rigidly hierarchical society with rights based on birth.

Society was more fluid, with intermarriage between landed gentry and urban money commonplace, and upward mobility unremarkable. <sup>146</sup>

In Britain, legal definitions of rank below the peerage were vanishing fast, and divisions between country and town becoming blurred. <sup>146</sup>

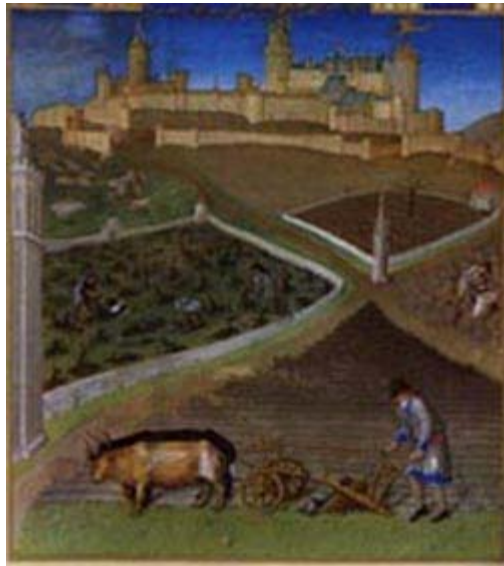
Now the English parliament became a focus for public political debate.<sup>156</sup> With flexibility based on growing freedom, and the ability to remove ineffectual leaders, Britain was preadapted for adapting to rapidly changing environments.



# The Sun King and His Legacy

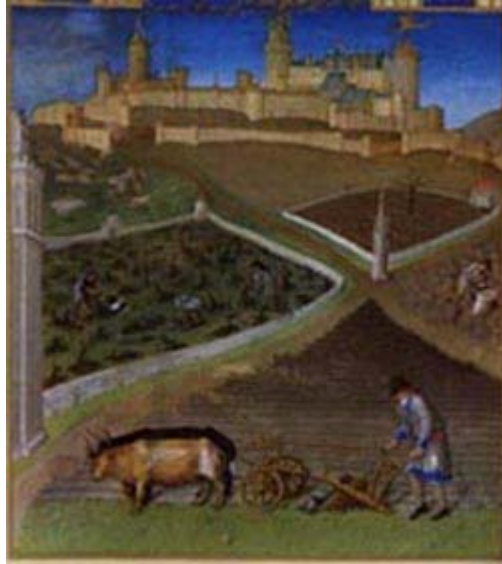


As Britain experienced its slow agricultural revolution, millions of King Louis XIV's subjects still lived in an agricultural world little changed from medieval times.



Hippolyte Taine wrote of the French poor, *“The people are like a man wading in a pond with water up to his mouth: the slightest dip in the ground, the slightest ripple, makes him lose his footing — he sinks and chokes.”*

Compared with England or the Low Countries most French agriculture was astoundingly backward.

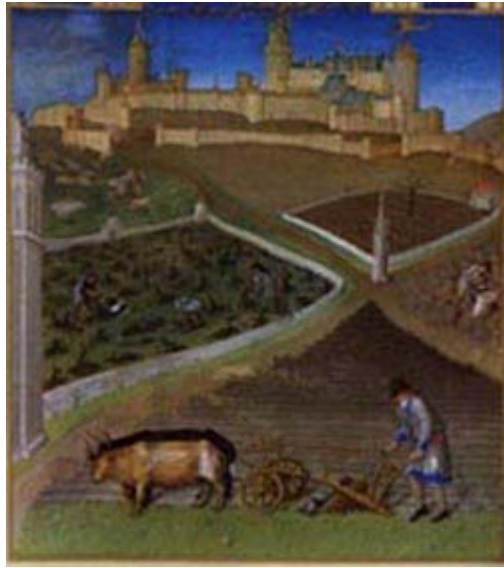


Much of France was on the subsistence edge.

Rising population densities made the situation worse.

Yet, deeply conservative and suspicious of innovation, the peasants opposed any measures that increased hay crops or hectarage devoted to orchards.





For the most part, the French peasantry turned up their noses at potatoes and other new foods and relied on cereal crops and vines for survival – the cereals to eat, their grapes for some cash.

During the Medieval Warm, when climate shocks were absent, farmers could produce enough to get by. But with the shocks of the Little Ice Age the French farmer came under increasing duress.

Unlike Great Britain at the same time, which became less vulnerable to cycles of climate-triggered crop failures, France remained stagnant – in large part because of the leadership of the country.

France's rulers, like England's Tudors, were well aware of their country's chronic food shortages. Nor were they short on advice as to what to do. . . .

. . . They just lacked the will.



# The French Nobility

Louis XIV, the Sun King, was an absolute monarch, symbol of his age, the epitome of the purest form of supreme kingship.

Neither Louis XIV or his successors Louis XV and XVI were unintelligent, but they were not rulers of initiative or innovative ideas.

The court thrived on intrigue and privilege, especially for those with the king's ear who had a vested interest in the status quo.



# The French Nobility

The king's ministers took great interest in foreign trade, but neglected agriculture.

The bitterly cold winters of the late seventeenth century found France ill prepared for food shortages.



In the end, a tenth of Louis XIV's subjects perished from famine and its attendant epidemics . . . The glittering life at Versailles continued unaffected.

No one concerned with political change in France paid much attention to the peasantry, who fed them and bore the brunt of poor harvests.



# The French Nobility

French agriculture was far from stagnant, but the indifference of many landowners and the social chasm between those of noble birth, the rich generally, and the poor made widespread reform a virtual impossibility.



Between 1670 and 1700 Louis XIV waged almost continuous war on his neighbors, during years when the cooler, unpredictable weather caused frequent poor harvests and agricultural production declined.

# The French Revolution





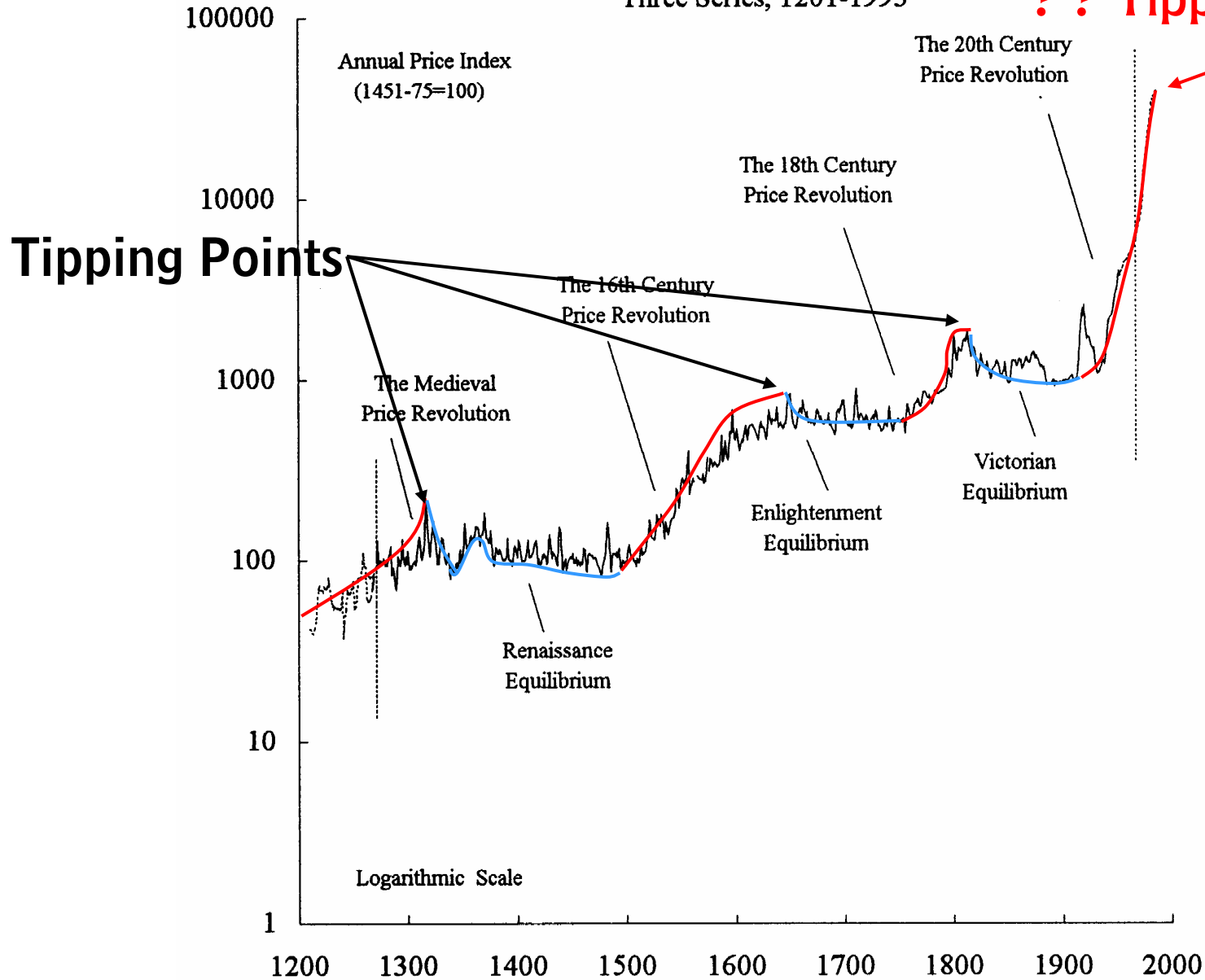
**The Kind of  
Problem the  
Environment Is**

# #2 - Economic Tipping Point

## The Price of Consumables in England

Three Series, 1201-1993

?? Tipping Point ??



The issue of global warming is a bigger issue than humans have faced in the past 12,000 years.

*“Today’s Baby Boomers had the privilege of growing up in one of the most stable periods in the vast sweep of human history.”*

Eugene Linden

Thus we are clearly having trouble coming to grips with it.

*Senate Rejects Global Warming Bill*  
*WASHINGTON, Oct. 30, 2003*



*Sen. James Inhofe, R–Okla., chairman of the Senate Environment and Public Works Committee and the bill's biggest opponent, said, "Like Kyoto, this is an extreme approach." Inhofe has called global warming a hoax perpetrated by environmentalists on the American public.*

But, it is also an emotionally charged ideological struggle.

*Global warming is a hoax perpetrated by environmental extremists and liberals who want an excuse for more big government (and/or world government via the U.N.).*

<http://gristmill.grist.org/story/2006/11/11/23656/027>

And we know that in stressful times ideological polarization becomes more prominent.

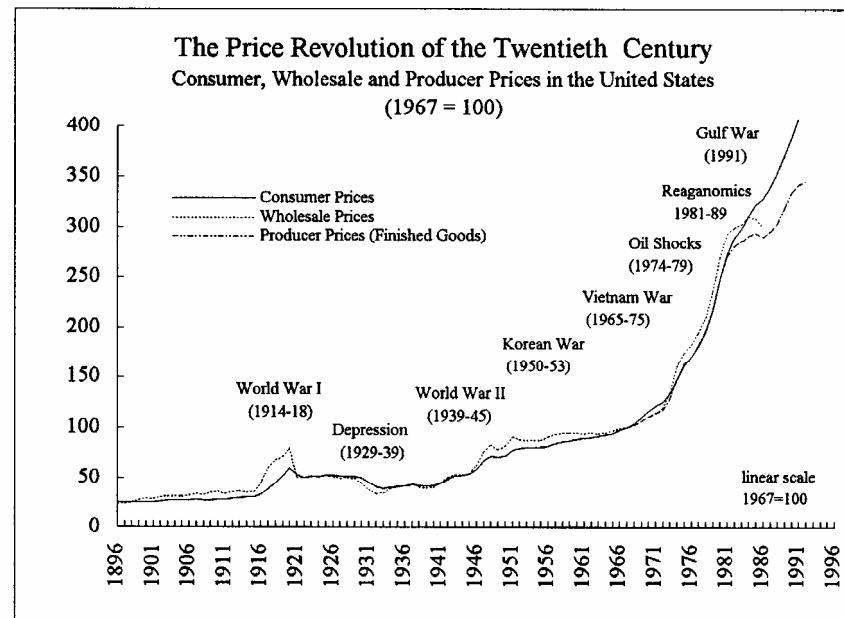
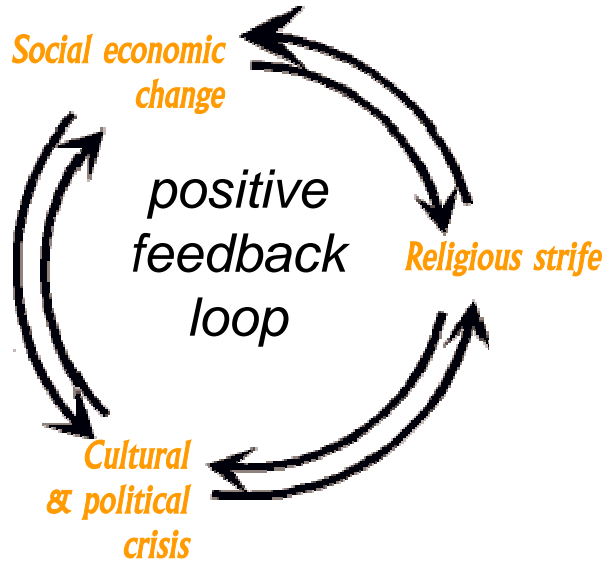


Figure 4.01 surveys annual price movements in the United States. Sources include *Historical Statistics of the United States* (1976), series E23, E135; *Statistical Abstract of the United States* (1988), table 735; *Statistical Abstract of the United States* (1993), tables 756, 764.



# Extrinsic Feedback Loop

Background of rising psychic/emotional energy

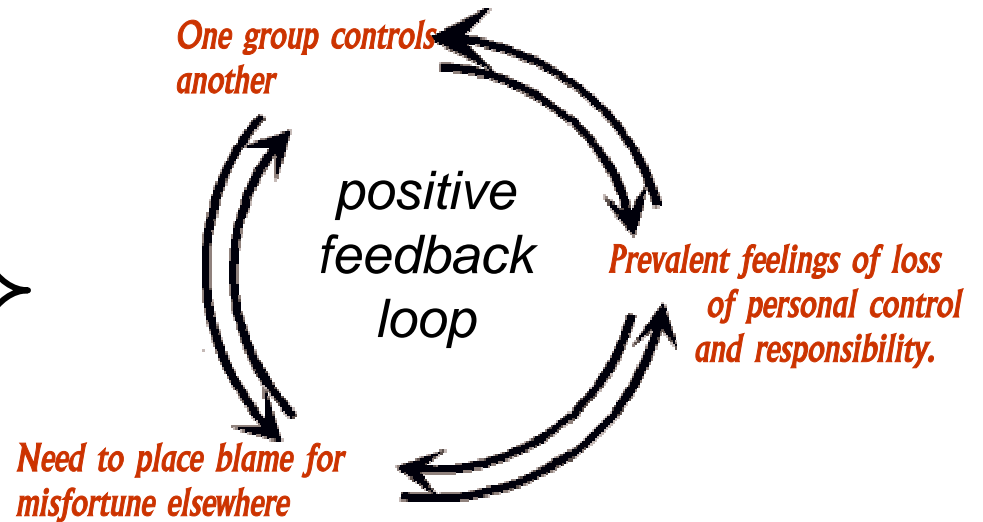


All increase 'r'

Rising anxiety needing to be dissipated

# Intrinsic Feedback Loop

Specific ways the energy is released



The anxiety needs a specific focus for its energy, a scapegoat

Perry Levels 1, 2, or 3

*There are right and wrong answers known to authorities and our responsibility is to obey them; i.e. an abdication of personal responsibility*

We are living at a time when we as a species are especially vulnerable.

Our hubris about both global warming, and the critical economic great wave is partly because we just don't have the scientific perspective, the personal perspective, or the memory to remember that dramatically great changes are possible, and that they happen quickly.

We have been able to beat the system because recent changes have been minor.

Yet we have several choices in front of us.

1. We can simply hope the knockout blow never comes.



2. We can hope that our technological brilliance – especially in information technology and biotechnology - is the extraordinary innovation that provides an escape hatch.



But, these questions may belong to what Garrett Hardin (1915 – 2003) called *the class of problems with non-technological solutions*.

It is not the world we have to change, it is ourselves.



We should always remember that the societies that sustained themselves over the true long haul – over millennia, did so by reaching an accommodation with their environment.



We have met the enemy and he is us.



# Four Viewpoints

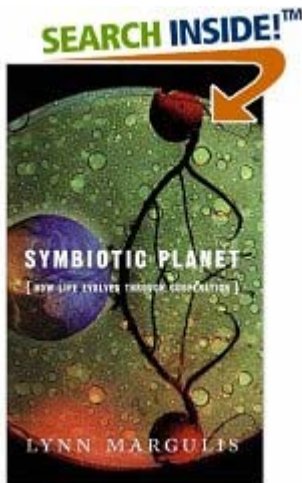
Time Magazine, April 9, 2007, page 52

*“It was probably always too much to believe that human beings would be responsible stewards of the planet. We may be the smartest of all the animals, endowed with exponentially greater powers of insight and abstraction, but we’re animals all the same. That means that we can also be shortsighted and brutish, hungry for food, resources, land – and heedless of the mess we leave behind trying to get them.”*

# Gaia Theory



To me, the human move to take responsibility for the living Earth is laughable the rhetoric of the powerless.



The planet takes care of us, not we of it. Our self-inflated moral imperative to guide a wayward Earth or heal our sick planet is evidence of our immense capacity for self-delusion. Rather, we need to protect us from ourselves.

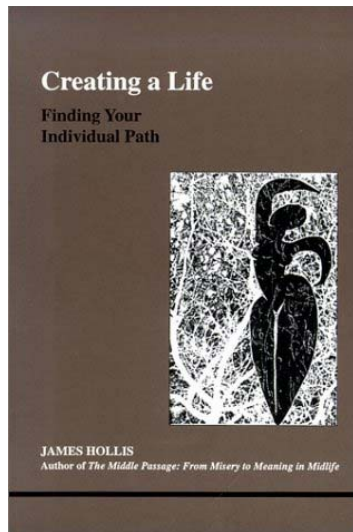


*Understanding Our Moment in History:  
An Interview with Richard Tarnas*

## **The Great Initiation**

Imagine you are the universe, a deep, beautiful, ensouled universe, and you are being courted by a suitor. Would you open your deepest secrets to the suitor—that is, to the methodology, the epistemology—who would approach you as though you were unconscious, utterly lacking in intelligence or purpose, and inferior in being to him; who related to you as though you were ultimately there for his exploitation, development, and self-enhancement; and his motivation for knowing you is driven essentially by a desire for prediction and control for his own self-betterment? Or would you open your deepest secrets to that suitor—that epistemology, that methodology—who viewed you as being at least as intelligent and powerful and full of mystery as he is, and who sought to know you by uniting with you to create something new?





A more recalcitrant feature of the human psyche is hinted at by St. Paul when he admits that though he often knew the good, he did not always, or often, choose the good.



The Pauline qualification of missing the mark introduces a more sinister dimension to the matter, much closer to that intimated in hubris.

Something within us seeks destruction. Hubris involves the extension of human possibility beyond the humanly possible. It involves crossing the line, even when the line is invisible.

Change on our own seems to be very difficult for us to do, and individuals, let alone nations are rarely up to it.

Change usually become possible only when the catastrophic consequences of our behavior become so overwhelming that we have no choice.

We either change, or we die  
(although along the way there is usually a dark night of the soul).

# The Earth Does Not Have an Environmental Problem

We humans have  
environmental  
problems, . . . But the  
Earth does not.