Perilous Times 2*

2Timothy 3:1-5 (1) This know also, that in the last days perilous times shall come.
(2) For men shall be lovers of their own selves, covetous, boasters, proud, blasphemers, disobedient to parents, unthankful, unholy,
(3) Without natural affection, trucebreakers, false accusers, incontinent, fierce, despisers of those that are good,
(4) Traitors, heady, highminded, lovers of pleasures more than lovers of God;
(5) Having a form of godliness, but denying the power thereof: from such turn away.
Perilous times will come because of these characters, and of those having these identifying traits; from such turn away! *The determined effort of these unscrupulous people to corrupt the gospel and destroy the work of Christ, knowingly or unknowingly, is one of the burdens of the new testament. Altho attacked by satan himself transformed as an angel of light and his ministers transformed as the ministers of righteousness, his army of atheist in religion (Islam) and government (socialism) and his science falsely so called, shall not defeat the gospel. Perilous times may be a famine of the word of God, as the characters we just read of certainly do nothing to further the gospel message, but in fact detract from it. We can readily see that these characters will exist, but what is it they do that cause perilous times? Tho it is difficult to predict future events, can we know what will happen when the gospel is no longer attracting interest? Yes we can. Let's turn to;*
Luke 17:26-30 (26) And as it was in the days of Noe, so shall it be also in the days of the Son of man.
(27) They did eat, they drank, they married wives, they were given in marriage, until the day that Noe entered into the ark, and the flood came, and destroyed them all.

(28) Likewise also as it was in the days of Lot; they did eat, they drank, they bought, they sold, they planted, they builded;
(29) But the same day that Lot went out of Sodom it rained fire and brimstone from heaven, and destroyed them all.
(30) Even thus shall it be in the day when the Son of man is revealed.

The flood came upon the earth because of wickedness in which mankind willing persisted, perhaps there were characters in Noah's day deserving of descriptions we read of in 2Timothy. In the beginning of the flood, great calamities came in abundance, such as the world had never seen. The word "flood", of itself, does not describe the groaning and travailing associated with such an event; In the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the same day were **all the fountains** of the great deep broken up, and the windows of heaven were opened (Gen 7:11). *Perhaps all have heard of the "ring of fire", so called because that is where the continental plates collide and separate under great pressure causing earthquakes and volcanoes. Now just imagine the enormity of an event if all were broken up at the same time. Such a magnitude of earthquakes would surly cause a rising and falling of land masses that one may think the world was splitting apart. Can one imagine the magnitude of tsunamis in terms of quantity and fearsomeness as they race around the globe. And the breaking up of all the volcanoes under the oceans would drive horrendous amounts of mist, steam and water into the atmosphere, that when falling back like rain to the surface, would be world wide in scope. And then in addition to that, imagine a storm raining down torrents of water for 40 full days. In light of such an event, what can we expect upon the return of Christ? There is no better place to turn to than;*

2Peter 3:1-7 (1) This second epistle, beloved, I now write unto you; in both which I stir up your pure minds by way of remembrance:

(2) That ye may be mindful of the words which were spoken before by the holy prophets, and of the commandment of us the apostles of the Lord and Saviour:
(3) Knowing this first, that there shall come in the last days scoffers, walking after their own lusts,
(4) And saying, Where is the promise of his coming? for since the fathers fell asleep, all things continue as they were from the beginning of the creation.
(5) For this they willingly are ignorant of, that by the word of God the heavens were of old, and the earth standing out of the water and in the water:
(6) Whereby the world that then was, being overflowed with water, perished:
(7) But the heavens and the earth, which are now, by the same word are kept in store, reserved unto fire against the day of judgment and perdition of ungodly men.
The present earth and its atmosphere, which are liable to the same destruction, because the same means still exist, (for there is still water enough to drown the earth, and there is iniquity enough to induce God to destroy it and its inhabitants), but are nevertheless kept in store, τεθησαυρισμενοι, to be destroyed, not by water, but by fire at the day of judgment. Had these scoffers believed the dreadful vengeance with which God swept away a whole world of ungodly men at once, surely they would not have scoffed at His word. As a result of unbelief, ungodly men are rushing toward a hellish nightmare! Have calamities occurred that should convince the world of the latter days? Please turn to;
Revelation 16:1-2 (1) And I heard a great voice out of the temple saying to the seven angels, Go your ways, and pour out the vials of the wrath of God upon the earth.
(2) And the first went, and poured out his vial upon the earth; and there fell a noisome and grievous sore upon the men which had the mark of the beast, and upon them which worshipped his image.

Keep in mind that parts of Revelation are difficult to understand because of the symbolic writing. Revelation 15:1 *revealed;* another sign in heaven, great and marvelous, seven angels having the seven last plagues; for in them is filled up the wrath of God. *Revelation chapters 1 and 22 declare the time of fulfillment would begin soon, tho there is a time horizon between the two. There was an event that closely resembles the noisome and grievous sore poured out of the first vial, but please keep an open mind. That possibility is this; coming out of the East, the Black Death reached the shores of Italy in the spring of 1348 unleashing a rampage of death across Europe unprecedented in recorded history. By the time the epidemic played itself out three years later, anywhere between 25% and 50% of Europe's population had fallen victim to the pestilence. Such was the multitude of corpses brought to the churches every day and almost every hour that there was not enough consecrated ground to give them burial, especially since they wanted to bury each person in the family grave, according to the old custom. Noisome means; harmful or injurious to health; noxious. Synonyms include putrid, rotten, stinking. The Black Plague symptoms were swollen lymph nodes in the neck, armpit and/or groin, which oozed and bled (and often appeared black); high fever, and blood-laced vomit. Most died within one week after the appearance of symptoms. The swollen lymph nodes (buboes) were red in color initially. As the disease progressed, it turned dark purple to black in color. If the victim bled, the color of the blood was black in color, thick and had a very noisome smell. As the skin and blood turned black, the plague was known as Black Death. The 14th century eruption of the Black Death had a drastic effect on Europe's population, irrevocably changing the social structure. It was a serious blow to the Roman Catholic Church, and resulted in widespread persecution of minorities such as Jews, foreigners, beggars, and lepers. During the Middle Ages it was essential that people were given the last rites and had the*

chance to confess their sins before they died. The spread of the deadly plague in England was swift and the death rate was almost 50% in isolated populations such as monasteries. There were not enough clergy to offer the last rites or give support and help to the victims. The situation was so bad that Pope Clement VI was forced to grant "remission of sins" to all who died of the Black Death. Victims were allowed to confess their sins to one another. The apostate church could offer no reason for the deadly disease and beliefs were sorely tested. This had such a devastating effect that people started to question the legalized religion of the day and such doubts ultimately led to the English reformation. Is it just coincidence that the "noisome and grievous sore" of Revelation and the Black Plague epidemic match up so well. Could they be the same thing?

Thomas Linacer, the respected Oxford professor, and the personal physician to both King Henry the 7th and 8th of England, on reading the New Testament for the first time (1524), Linacer said "Either this is not the gospel, or we are not Christians" having thrown the scriptures to one side. Churches of Christ prior to the Reformation were wide spread across Europe, persecuted by Protestants and Catholics alike. Calvin and Luther both worked furiously with hatred against the Lord's Church. Eventually it was Calvinism and denominationalism that almost destroyed the Lord's Church prior to the Restoration Movement of the early nineteenth century, with few congregations surviving to that time. Restoration and Reformation must not be confused. Restoration leads back to the pure, Jerusalem gospel. Reformation leads back to Rome and the Roman gospel which was three hundred years too late, being based on the pagan system of total depravity (original sin), fatalism and salvation through good works, tho replaced by the Reformers claiming salvation through 'Grace' and Faith Only! Next turn to;

Revelation 16:8-9 (8) And the fourth angel poured out his vial

upon the sun; and power was given unto him to scorch men with fire.
(9) And men were scorched with great heat, and blasphemed the name of God, which hath power over these plagues: and they repented not to give him glory.
The effect was as if it had been poured upon the sun, giving it an intense heat, and thus inflicting a severe judgment upon people. The idea is, that a scene of calamity and woe would occur as if the sun should be made to pour forth such intense heat that people would be "scorched." The notion of intense or consuming heat is implied in all the forms of the word; and the reference here is to some calamity that would be well represented by such an increased heat of the sun. It is said that this calamity would come upon people, and we are to suppose that it would be such that human life would be particularly affected; and as that heat of the sun must be exceedingly intense which would cut down people, we are to suppose that the judgment here referred to would be intensely severe. And they would blaspheme God who hath power over these plagues. The drama of the past few years is "global warming." Men of high stature say man hath power over global warming. But they repent not to give God glory who hath power over these plagues. The effect has not produced repentance, though it was manifest that these judgments had come upon them on account of their sins. The world is awash in sin, the lust of the flesh, the lust of the eyes and the pride of life. Because of this, is global warming the beginning of the sun plague? Listen to this;
*Posted on MSN, May 26, 2015--***India heatwave kills 800 as capital's roads melt;** At least 800 people have died in a major heatwave that has swept across India, melting roads in New Delhi as temperatures neared 50 degrees Celsius (122 Fahrenheit). Hospitals are on alert to treat victims of heatstroke and authorities advised people to stay indoors with no end in sight to the searing conditions.

However, there will be no confusion of the day of the Lord, when the heavens, the elements, and the earth shall be dissolved with great heat. Old things must pass away because of the coming of the day of God; the old order must give place to the new. Looking for and hasting unto the coming of the day of God, wherein the heavens being on fire shall be dissolved, and the elements shall melt with fervent heat? (2Peter 3:12). *The apostle repeats the striking words which he had already used with a different verb. The Greek word for "shall melt" here is not (λυθήσεται) the same as in verse 10, but a stronger word (τήκεται), are being melted, or wasted away. The true Christian does not dread the coming of that day. He looks forward to it as the period of his redemption, and would welcome, at any time, the return of his Lord and Saviour. While he is willing to wait as long as it shall please God for the advent of His Redeemer, yet to him the brightest prospect in the future, is that hour when He shall come to take believers to Himself.*

From-**"Global Warming" -- Another Name For Population Reduction**

{Dame Margaret Mead, chaired a conference in November 1975 on "The Atmosphere: Endangered or Endangering." Scientists who attended that conference, warning about a coming Ice Age such as Stephen Schneider, left the conference promoting global warming. Mead told the assembled scientists: The unparalleled increase in the human population and its demands for food, energy, and resources is clearly the most important destabilizing influence in the biosphere. We are facing a period when society must make decisions on an planetary scale. What we need from scientists are estimates, presented with sufficient conservatism and plausibility, that will allow us to start building a system of artificial, but effective warnings, warnings which will parallel the instincts of animals which flee the hurricane...." Mead went on to say, that the point is to draw from people their capacity for "sacrifice." In other words,

scientists should create artificial but plausible stories that will sufficiently scare people, that they will give up their standard of living and modern industrial society--and in the process kill off half or more of the world's population.}
I cannot confirm or deny the truthfulness of the article, but if true, times could become perilous. In addition to the changes in the Earth's orbit that contribute to global warming, the sun goes through cycles where its output increases, causing the Earth's atmosphere to warm up and create warmer than average weather. Scientists have discovered several possible cycle lengths for sun output activity ranging from every 11 years up to every 720 years. During the course of these cycles, the sun releases more energy, resulting in climate changes and an increased number of solar flares. Now let's turn to;
Revelation 16:17-21 (17) And the seventh angel poured out his vial into the air; and there came a great voice out of the temple of heaven, from the throne, saying, It is done.
(18) And there were voices, and thunders, and lightnings; and there was a great earthquake, such as was not since men were upon the earth, so mighty an earthquake, and so great.
(19) And the great city was divided into three parts, and the cities of the nations fell: and great Babylon came in remembrance before God, to give unto her the cup of the wine of the fierceness of his wrath.
(20) And every island fled away, and the mountains were not found.
(21) And there fell upon men a great hail out of heaven, every stone about the weight of a talent: and men blasphemed God because of the plague of the hail; for the plague thereof was exceeding great.
And the seventh angel poured out his vial into the air saying it is done, by which is meant the kingdom of satan, he being the prince of the power of the air, (Ephesians 2:2). What the angel swore should be in the days of the seventh angel,

namely, that antichristian time should be no more, and the mystery of God in His purposes and providences should be finished, and all the glorious things spoken of His church and people should be accomplished. At the present time Jerusalem is part Christian, part Jewish and part Islam (3 parts), is Jerusalem that great city? If so—"It is come to pass." Expiation is made for our sins when they are punished not in ourselves but in another who consents to stand in our place. I cannot deny, but confirm that Jesus stood in our place. Hereby perceive we the love of God, because **he laid down his life for us**: and we ought to lay down our lives for the brethren (1 John 3:16). *Let's turn to;*

Acts 2:37-41 (37) Now when they heard this, they were pricked in their heart, and said unto Peter and to the rest of the apostles, Men and brethren, what shall we do?
(38) Then Peter said unto them, Repent, and be baptized every one of you in the name of Jesus Christ for the remission of sins, and ye shall receive the gift of the Holy Ghost.
(39) For the promise is unto you, and to your children, and to all that are afar off, even as many as the Lord our God shall call.
(40) And with many other words did he testify and exhort, saying, Save yourselves from this untoward generation.
(41) Then they that gladly received his word were baptized: and the same day there were **added unto them** about three thousand souls.

Believers only are baptized for remission of sin and it is they who are added to the Church by the Lord. During the first few centuries of the Church no central organization was found. Each congregation was autonomous, but fellowshipped with other congregations. Converts were made by preaching (evangelizing). When a new convert made the decision to become a 'Christian', he or she was baptized by immersion in water for the forgiveness of their sins without delay. The main worship service was held on the first day of the week

(Sunday) when the Lord's Supper was taken by all baptized believers in a solemn memorial to Christ. This I cannot deny, but confirm as it is the practice of the Church by example and command. But because of the characters described in 2Timothy; having a form of godliness, but denying the power thereof*: doctrine's of people such as Mohammedans should be avoided. However it need not be perilous times at judgment, both before (Jo 3:5) and after His crucifixion (Mk 16:16), Jesus secured and confirmed the ordinance of baptism for remission of sin and entrance into the Kingdom. He accordingly has therein declared all men without distinction, who will through faith as obedient children, heed, follow, and practice what faith contains to be His children and lawful heirs. He, therefore who neglects the life of the soul, casts away his present good; he who refuses to live to God, squanders all he has.*

The devil is a noteworthy adversary, however he can be defeated by faith. But what is faith? Faith in Christ is the effect of belief, and baptism is the effect of faith; only those who have first believed the testimony of God, then by faith repent of their sins, and declair that confession of faith, and by faith are baptized into His death, have the full and explicit testimony of pardon. This is the gospel. Therefore only those who admit their need of salvation and accept God's grace on His terms can be saved. Also if one needs prayer; The spirit and the bride say come while we gently persuade with song.

This message approved by
Jack Warford
a minister for Christ

India heatwave kills 800 as capital's roads melt

At least 800 people have died in a major heatwave that has swept across India, melting roads in New Delhi as temperatures neared 50 degrees Celsius (122 Fahrenheit).

Hospitals are on alert to treat victims of heatstroke and authorities advised people to stay indoors with no end in sight to the searing conditions.

In the worst-hit state of Andhra Pradesh, in the south, 551 people have died in the past week as temperatures hit 47 degrees Celsius on Monday.

"The state government has taken up education programmes through television and other media to tell people not to venture into the outside without a cap, to drink water and other measures," said P. Tulsi Rani, special commissioner for disaster management in the state.

"We have also requested NGOs and government organisations to open up drinking water camps so that water will be readily available for all the people in the towns."

Large parts of India, including the capital New Delhi, have endured days of sweltering heat, prompting fears of power cuts as energy-guzzling air conditioners work overtime.

The Hindustan Times daily said the maximum temperature in the capital hit a two-year high of 45.5 degrees Celsius on Monday -- five degrees higher than the seasonal average.

The paper carried a front-page photo of a main road in the city melting in the heat, its zebra pedestrian crossing stripes curling and spreading into the asphalt.

"It's baking hot out here -- our outing has turned into a nightmare," said Meena Sheshadri, a 37-year-old tourist from the western city of Pune who was visiting Delhi's India Gate monument with her children.

"My throat is parched, even though I've been constantly sipping water."

In Telangana state, which borders Andhra Pradesh in the south, 231 people have died in the last week as temperatures hit 48 degrees Celsius over the weekend.

In the western state of Orissa 11 people were confirmed to have died from the heat.

India's Meteorological Department issued a "Red Box" warning for the state Tuesday and Wednesday -- meaning the maximum temperatures would remain above 45 degrees Celsius.

Another 13 people have died in the eastern state of West Bengal, where unions urged drivers in the city of Kolkata to stay off the roads during the day.

Hundreds of people -- mainly from the poorest sections of society -- die at the height of summer every year across the country, while tens of thousands suffer power cuts from an overburdened electricity grid.

India's power industry has long struggled to meet rapidly rising demand in Asia's third largest economy, with poorly maintained transmission lines and overloaded grids.

With no end in sight to the hot, dry conditions, the Hindustan Times warned that some of the worst-affected states could be plunged into drought before the monsoon rains arrive.

The monsoon is forecast to hit the southern state of Kerala towards the end of this month before sweeping across the country, but it will be weeks before the rains reach the arid northern plains.

MSN May 26, 2015

TheMiddleAges.net The Black Death: Bubonic Plague

In the early 1330s an outbreak of deadly bubonic plague occurred in China. The bubonic plague mainly affects rodents, but fleas can transmit the disease to people. Once people are infected, they infect others very rapidly. Plague causes fever and a painful swelling of the lymph glands called buboes, which is how it gets its name. The disease also causes spots on the skin that are red at first and then turn black.

Since China was one of the busiest of the world's trading nations, it was only a matter of time before the outbreak of plague in China spread to western Asia and Europe. In October of 1347, several Italian merchant ships returned from a trip to the Black Sea, one of the key links in trade with China. When the ships docked in Sicily, many of those on board were already dying of plague. Within days the disease spread to the city and the surrounding countryside. An eyewitness tells what happened: "Realizing what a deadly disaster had come to them, the people quickly drove the Italians from their city. But the disease remained, and soon death was everywhere. Fathers abandoned their sick sons. Lawyers refused to come and make out wills for the dying. Friars and nuns were left to care for the sick, and monasteries and convents were soon deserted, as they were stricken, too. Bodies were left in empty houses, and there was no one to give them a Christian burial."

The disease struck and killed people with terrible speed. The Italian writer Boccaccio said its victims often "ate lunch with their friends and dinner with their ancestors in paradise."

By the following August, the plague had spread as far north as England, where people called it "The Black Death" because of the black spots it produced on the skin. A terrible killer was loose across Europe, and Medieval medicine had nothing to combat it.

In winter the disease seemed to disappear, but only because fleas--which were now helping to carry it from person to person--are dormant then. Each spring, the plague attacked again, killing new victims. After five years 25 million people were dead--one-third of Europe's people. Even when the worst was over, smaller outbreaks continued, not just for years, but for centuries. The survivors lived in constant fear of the plague's return, and the disease did not disappear until the 1600s.

Medieval society never recovered from the results of the plague. So many people had died that there were serious labor shortages all over Europe. This led workers to demand higher wages, but landlords refused those demands. By the end of the 1300s peasant revolts broke out in England, France, Belgium and Italy.

The disease took its toll on the church as well. People throughout Christendom had prayed devoutly for deliverance from the plague. Why hadn't those prayers been answered? A new period of political turmoil and philosophical questioning lay ahead.

Black Death - Disaster Strikes

25 million people died in just under five years between 1347 and 1352. Estimated population of Europe from 1000 to 1352.

1000 38 million, 1100 48 million
1200 59 million, 1300 70 million
1347 75 million, 1352 50 million

For more information about the plague on this site, see:

Black Death Spreads
Bubonic Plague: Will it Ever End?
I Saw the Black Death
The Medieval Miracles of Healing -- Medical Science
The Plague: an account from Boccaccio's The Decameron

Additional site on the plague:

Maps by EyeWitness to History - historical information and maps provided by EyeWitness to History
Plague and Public Health in Renaissance Europe
Fleas - site about the insects responsible for the Black Death

Medieval Life and Times Home---Medieval History
Medieval History - Black Death

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The Black Death Victims in Medieval Times - The daughter of the King of England
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Black Death

Facts and interesting information about the lives and events of Medieval History, specifically, the Black Death

Black Death

The Medieval Times encompass one of the most exciting periods in the History of England and Europe. One of the most important historical events of the Medieval era is the Black Death. What were the key dates of this famous historical event? What were the names of the Medieval people who were involved in this historical occasion? Interesting facts and information about the Black Death are detailed below.

Important Facts about the Black Death

Interesting information and important facts and history of the disease:

Key Dates relating to the event: This terrible plague started in Europe in 1328 and lasted until 1351 although there were outbreaks for the next sixty years

Why was the disease called the Black Death? The disease was called the Black Death because one of the symptoms produced a blackening of the skin around the swellings. or buboes. The buboes were red at first, but later turned a dark purple, or black. When a victim's blood was let the blood that exuded was black, thick and vile smelling with a greenish scum mixed in it.

How the disease was spread: The Black Death was spread by fleas that were carried by rats or other small rodents

The spread of the Black Death followed all of the Trade Routes to every country

The Black Death of the Middle Ages was believed to have originated in the Gobi Desert

Key People relating to the event: Nearly one third of the population of died - about 200 million people in Europe

The 1328 outbreak in China caused the population to drop from 125 million to 90 million in just fifty years

7500 victims of the disease were dying every day

The Black Death in England raged from 1348-1350

Why the Black Death was important to the history of England: The population drop resulted in a higher value being placed on labour - the Peasants Revolt followed in 1381. Farming changed and the wool industry boomed. People became disillusioned with the church and its power and influence went into decline. This ultimately resulted in the English reformation

Black Death Symptoms

The symptoms of the Black Death were terrible and swift:

Painful swellings (buboes) of the lymph nodes
These swellings, or buboes, would appear in the armpits, legs, neck, or groin
A bubo was at first a red color. The bubo then turned a dark purple color, or black
Other symptoms of the Black Death included:
- a very high fever
- delirium
- the victim begins to vomit
- muscular pains

bleeding in the lungs
mental disorientation

The plague also produced in the victim an intense desire to sleep, which, if yielded to, quickly proved fatal

A victim would die quickly - victims only lived between 2 -4 days after contracting the deadly disease

Black Death Victims in Medieval Times - Treatments

The Black Death victims in Medieval Times were terrified of the deadly disease. The plague held a massive mortality rate between 30 and 40%. Victims had no idea what had caused the disease. Neither did the physicians in Medieval Times. The most that could be done was that various concoctions of herbs might be administered to relieve the symptoms - there was no known cure. Headaches were relieved by rose, lavender, sage and bay. Sickness or nausea was treated with wormwood, mint, and balm. Lung problems were treated with liquorice and comfrey. Vinegar was used as a cleansing agent as it was believed that it would kill disease. But bloodletting was commonly thought to be one of the best ways to treat the plague. The blood that exuded was black, thick and vile smelling with a greenish scum mixed in it.

Black Death Treatment: Black Death was treated by lancing the buboes and applying a warm poultice of butter, onion and garlic. Various other remedies were tried including tobacco, arsenic, lily root and dried toad!

Black Death in England - 1348-1350

The Black Death reached England in 1348. Bristol was an important European port and city in England during the Medieval era. It is widely believed that Bristol was the place where the Black Death first reached England. The plague reached England during the summer months between June and August. The Back Death reached London by 1st November 1348. London was a crowded, bustling city with a population of around 70,000. The sanitation in London was poor and living conditions were filthy. The River Thames brought more ships and infection to London which spread to the rest of England. The crowded, dirty living conditions of the English cities led to the rapid spread of the disease. Church records that the actual deaths in London were approximately 20,000. Between 1348 and 1350, killed about 30 - 40% of the population of England which at the time was estimated to be about five to six million. Many people were thrown into open communal pits. The oldest, youngest and poorest died first. Whole villages and towns in England simply ceased to exist after the Black Death.

Black Death during the Elizabethan Era

The Black Death Victims in Medieval Times - The daughter of the King of England

The Black Death struck people and took its victims from all walks of society. King Edward III (1312 – 1377) was King of England during the terrible period of the plague. Edward had arranged a marriage for his favourite daughter Joan Plantagenet. Joan was born in February 1335 in Woodstock. Joan was to marry King Pedro of Castille, the son of Alfonso XI and Maria of Portugal. The marriage was to take place in Castille. Joan (sometimes referred to as Joanna) left England with the blessing of her parents. The Black Death had not yet taken its hold in England and its first victims had only been claimed in France in August 1348. Joan travelled through France and contracted the deadly disease. She died on 2 Sep 1348 in Bayonne of the Black Death.

The Black Death and Religion

During the Middle Ages it was essential that people were given the last rites and had the chance to confess their sins before they died. The spread of the deadly plague in England was swift and the death rate was almost 50% in isolated populations such as monasteries. There were not enough clergy to offer the last rites or give support and help to the victims. The situation was so bad that Pope Clement VI was forced to grant remission of sins to all who died of the Black Death. Victims were allowed to confess their sins to one another, or "even to a woman". The church could offer no reason for the deadly disease and beliefs were sorely tested. This had such a devastating effect that people started to question religion and such doubts ultimately led to the English reformation.

Consequences and Effects of the Black Death plague

The Consequences and effects of the Black Death plague were far reaching in England:

- Prices and Wages rose
- Greater value was placed on labour
- Farming land was given over to pasturing, which was much less labour-intensive
- This change in farming led to a boost in the cloth and woollen industry
- Peasants moved from the country to the towns
- The Black Death was therefore also responsible for the decline of the Feudal system
- People became disillusioned with the church and its power and influence went into decline
- This resulted in the English reformation

Black Death

The Medieval Times website provides interesting facts, history and information about these great people and important historical events which scatter the Medieval History books including the Black Death. The Medieval Times Sitemap provides full details of all of the information and facts about the fascinating subject of the lives of the people who lived during the historical period of the Middle Ages. The content of this article on Medieval life and times provides free educational details, facts and information for reference and research for schools, colleges and homework for history courses and history coursework.

Medieval History - Black Death

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The Black Death, 1348

Coming out of the East, the Black Death reached the shores of Italy in the spring of 1348 unleashing a rampage of death across Europe unprecedented in recorded history. By the time the epidemic played itself out three years later, anywhere between 25% and 50% of Europe's population had fallen victim to the pestilence.

The plague presented itself in three interrelated forms. The bubonic variant (the most common) derives its name from the swellings or buboes that appeared on a victim's neck, armpits or groin. These tumors could range in size from that of an egg to that of an apple. Although some survived the painful ordeal, the manifestation of these lesions usually signaled the victim had a life expectancy of up to a week. Infected fleas that attached themselves to rats and then to humans spread this bubonic type of the plague. A second variation - pneumonic plague - attacked the respiratory system and was spread by merely breathing the exhaled air of a victim. It was much more virulent than its bubonic cousin - life expectancy was measured in one or two days. Finally, the septicemic version of the disease attacked the blood system. Having no defense and no understanding of the cause of the pestilence, the men, women and children caught in its onslaught were bewildered, panicked, and finally devastated.

The Italian writer Giovanni Boccaccio lived through the plague as it ravaged the city of Florence in 1348. The experience inspired him to write The Decameron, a story of seven men and three women who escape the disease by fleeing to a villa outside the city. In his introduction to the fictional portion of his book, Boccaccio gives a graphic description of the effects of the epidemic on his city.

The Signs of Impending Death

"The symptoms were not the same as in the East, where a gush of blood from the nose was the plain sign of inevitable death; but it began both in men and women with certain swellings in the groin or under the armpit. They grew to the size of a small apple or an egg, more or less, and were vulgarly called tumours. In a short space of time these tumours spread from the two parts named all over the body. Soon after this the symptoms changed and black or purple spots appeared on the arms or thighs or any other part of the body, sometimes a few large ones, sometimes many little ones. These spots were a certain sign of death, just as the original tumour had been and still remained.

No doctor's advice, no medicine could overcome or alleviate this disease, An enormous number of ignorant men and women set up as doctors in addition to those who were trained. Either the disease was such that no treatment was possible or the doctors were so ignorant that they did not know what caused it, and consequently could not administer the proper remedy. In any case very few recovered; most people died within about three days of the appearance of the tumours described above, most of them without any fever or other symptoms.

The violence of this disease was such that the sick communicated it to the healthy who came near them, just as a fire catches anything dry or oily near it. And it even went further. To speak to or go near the sick brought infection and a common death to the living; and moreover, to touch the clothes or anything else the sick had touched or worn gave the disease to the person touching. "

Varying Reactions to Disaster

"...Such fear and fanciful notions took possession of the living that almost all of them adopted the same cruel policy, which was entirely to avoid the sick and everything belonging to them. By so doing, each one thought he would secure his own safety.

Some thought that moderate living and the avoidance of all superfluity would preserve them from the epidemic. They formed small communities, living entirely separate from everybody else. They shut themselves up in houses where there were no sick, eating the finest food and drinking the best wine very temperately, avoiding all excess, allowing no news or discussion of death and sickness, and passing the time in music and suchlike pleasures. Others thought just the opposite. They thought the sure cure for the plague was to drink and be merry, to go about singing and amusing themselves, satisfying every appetite they could, laughing and jesting at what happened. They put their words into practice, spent day and night going from tavern to

tavern, drinking immoderately, or went into other people's houses, doing only those things which pleased them. This they could easily do because everyone felt doomed and had abandoned his property, so that most houses became common property and any stranger who went in made use of them as if he had owned them. And with all this bestial behaviour, they avoided the sick as much as possible.

In this suffering and misery of our city, the authority of human and divine laws almost disappeared, for, like other men, the ministers and the executors of the laws were all dead or sick or shut up with their families, so that no duties were carried out. Every man was therefore able to do as he pleased.

Many others adopted a course of life midway between the two just described. They did not restrict their victuals so much as the former, nor allow themselves to be drunken and dissolute like the latter, but satisfied their appetites moderately. They did not shut themselves up, but went about, carrying flowers or scented herbs or perfumes in their hands, in the belief that it was an excellent thing to comfort the brain with such odours; for the whole air was infected with the smell of dead bodies, of sick persons and medicines.

Others again held a still more cruel opinion, which they thought would keep them safe. They said that the only medicine against the plague-stricken was to go right away from them. Men and women, convinced of this and caring about nothing but themselves, abandoned their own city, their own houses, their dwellings, their relatives, their property, and went abroad or at least to the country round Florence, as if God's wrath in punishing men's wickedness with this plague would not follow them but strike only those who remained within the walls of the city, or as if they thought nobody in the city would remain alive and that its last hour had come."

The Breakdown of Social Order

"One citizen avoided another, hardly any neighbour troubled about others, relatives never or hardly ever visited each other. Moreover, such terror was struck into the hearts of men and women by this calamity, that brother abandoned brother, and the uncle his nephew, and the sister her brother, and very often the wife her husband. What is even worse and nearly incredible is that fathers and mothers refused to see and tend their children, as if they had not been theirs.

Thus, a multitude of sick men and women were left without any care, except from the charity of friends (but these were few), or the greed, of servants, though not many of these could be had even for high wages, Moreover, most of them were coarse-minded men and women, who did little more than bring the sick what they asked for or watch over them when they were dying. And very often these servants lost their lives and their earnings. Since the sick were thus abandoned by neighbours, relatives and friends, while servants were scarce, a habit sprang up which had never been heard of before. Beautiful and noble women, when they fell sick, did not scruple to take a young or old man-servant, whoever he might be, and with no sort of shame, expose every part of their bodies to these men as if they had been women, for they were compelled by the necessity of their sickness to do so. This, perhaps, was a cause of looser morals in those women who survived."

Mass Burials

"The plight of the lower and most of the middle classes was even more pitiful to behold. Most of them remained in their houses, either through poverty or in hopes of safety, and fell sick by thousands. Since they received no care and attention, almost all of them died. Many ended their lives in the streets both at night and during the day; and many others who died in their houses were only known to be dead because the neighbours smelled their decaying bodies. Dead bodies filled every corner. Most of them were treated in the same manner by the survivors, who were more concerned to get rid of their rotting bodies than moved by charity towards the dead. With the aid of porters, if they could get them, they carried the bodies out of the houses and laid them at the door; where every morning quantities of the dead might be seen. They then were laid on biers or, as these were often lacking, on tables.

Such was the multitude of corpses brought to the churches every day and almost every hour that there was not enough consecrated ground to give them burial, especially since they

wanted to bury each person in the family grave, according to the old custom. Although the cemeteries were full they were forced to dig huge trenches, where they buried the bodies by hundreds. Here they stowed them away like bales in the hold of a ship and covered them with a little earth, until the whole trench was full."

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The Black Death: Horseman of the Apocalypse in the Fourteenth Century

Abstract
In the fourteenth century, Europe suffered numerous catastrophes that would go down in history as "The Four Horsemen of the Apocalypse"; a reference to the book of Revelation in which four great ordeals which Earth had to endure in its final days before judgement. The Black Death stands out as the most dramatic and lifestyle changing event during this century. This was a widespread epidemic of the Bubonic Plague that passed from Asia and through Europe in the mid fourteenth century. The first signs of the Black Plague in Europe were present around the fall of 1347. In the span of three years, the Black Death killed one third of all the people in Europe. This traumatic population change coming into the Late Middle Ages caused great changes in European culture and lifestyle.

Historical Background

The Black Death was one of many catastrophes to occur following an increase in population during the High Middle Ages (1000-1300). The population of Europe grew from 38 million to 74 million in this time. Prior to the onset of the fourteenth century turmoil, Europe seemed to be in a state of growth in both agriculture and structure in society. Cities began to rise with artisans, farmers, and other crafts people specializing in their own field of work. The daily life contact between European people in the cities and surrounding villages facilitated the spread of this disease, as people did not possess sufficient medical knowledge to prevent the spread of the disease with any great success. The conditions in the cities also set the stage for disease. Waste accumulated in the streets for lack of sewer systems. Houses were crowded next to each other. One could not use the rivers for drinking water due to pollution. With all of these conditions arising from the High Middle Ages, it was only a matter of time before the population was curbed by disaster. The Black Death marks the barrier between the High Middle Ages and the Late Middle Ages, and the difference in Europe before and after the Black Death is clear.

Research Report

The origins of the Black Death can be traced back to the Gobi Desert of Mongolia in the 1320s. The cause of this sudden eruption of the plague is not exactly known. From the desert, it spread out in all directions. Of most importance was the spread eastward to China. China suffered an emergence of bubonic plague during the early 1330s. During the expansion of trade during the Early and High Middle ages, trade routes with China were strengthened and ventured greatly. European traders, particularly those from the Italian city states, traveled the Black Sea region regularly. Surviving documents show that one group of traders from Genoa arrived in Sicily In October of 1347, fresh from a voyage to China. This was most likely the introduction of the plague to European lands. Along with the Chinese goods on board, the traders carried the bacterium yersinia pestis in the rats on board as well as in some of the sailors themselves. The Black Death had arrived in Europe.

From Sicily, the plague spread at an alarming rate. The speed at which it spread and killed, as well as the horror which accompanied the diseased, caused a panic in the Italian population. Families were forced to abandon members who were sick. Lawyers refused to form wills for the dying. Entire monasteries were wiped out when they attempted to care for the dying, which caused great fear in charitable organizations. Other European countries looked toward Italians as being the cause of the plague, and there were many incidences of healthy Italian travelers and traders being exiled from villages or even killed out of fear of the plague spreading outside Italy. These measures proved futile, and the plague spread farther and farther north. Wherever trade routes existed, normally the plague would follow, radiating out from Italy. The Plague reached France shortly after Italy. Marseilles felt the effects in January of 1348 and Paris was infected in summer of the same year. England felt the effects in September of 1348. 1348 Europe suffered the most. By the end of 1348, Germany, France, England, Italy, and the low countries had all felt the plague. Norway was infected in 1349, and Eastern European countries began to fall victim during the early 1350s. Russia felt the effects later in 1351. By the end of this circular path around Europe, one third of all people in the infected areas had perished.

The people of Europe did not know that such a calamity was the result of a microscopic bacillus

bacterium. This organism was not new to the world in the fourteenth century, it had existed for millions of years prior. Europe actually had already felt a blow from the same plague earlier in the 6th century. The emergence at this particular time has unknown causes, yet some speculate that the "mini ice age", a climatic change felt in Europe prior to the Black Death, may have served in the process. Rodents are very susceptible to infection from the bacteria, especially common rats. These rats are also host to parasitic fleas, which live off of the blood of other animals. The flea is not affected by the bacterium, yet still carries it in the blood extracted from the rat host in its digestive tract. The flea's ability to carry the disease without death makes it a perfect conduit of transfer from organism to organism. When these rats inhabit urban areas or boats in order to live off of stored food supplies, they bring the fleas with them. Fleas leave the rat, which also dies shortly from the disease, and moves on to a new host; humans.

Once the flea bites a human, infected blood from the rat is introduced to the healthy blood of the human, and the bacteria spreads. Death occurs in less than a week for humans. A high fever, aching limbs, and fatigue mark the early stages of infection. Eventually, the lymph nodes of the neck, groin, and armpit areas swell and turn black. Those black swellings on victims are what give the Black Death its name. The victim begins to vomit blood and in some instances suffer hysteria from fever and terror. Exposure to any body fluids means exposure to the bacterium, and thus spreading the disease is very easy through coughing victims. The victim dies shortly after the lymph nodes swell until bursting within the body. Within a European village, by the time the initial carrier of the disease had perished, the disease would have already taken early stages in several other individuals, making prevention extreamly difficult.

The cycles of the seasons corresponded to cycles of infection. As winter approached, colder temperatures killed fleas and caused rats to seek dormancy. This gave the false appearance of an "all clear" in areas that had been ravaged by plague the previous summer. The disease was not gone, it was simply dormant for a few months. Europe was then taken by surprise with new outbreaks in new areas as temperatures again made for a hospitable environment for flea and rat populations.

The idea that the Black Death was solely caused by the bubonic strain of plague has been questioned. The bubonic plague is actually the weakest strain of known plagues. The other two strains are the septicaemic plague, which infects the circulatory system in victims, and the pneumonic plague, which infects the respiratory system. The fact that accounts from the time indicate that the Black Death killed virtually all infected people raises doubt. The bubonic plague is not as fatal compared to the other two strains (which have mortality rates close to 100%). The consideration to make is that malnutrition plays a major role in the furthering of the consequences of infection. Those groups most ravaged by the Black Death had already suffered from famine earlier in the fourteenth century as storms and drought caused crop failures. These malnourished peasants fell victim with little resistance from their weak immune systems.

Most first hand written accounts that are present today read like this one from the site of the first plague cases in Italy, Messina: "Here not only the "burn blisters" appeared, but there developed gland boils on the groin, the thighs, the arms, or on the neck. At first these were of the size of a hazel nut, and developed accompanied by violent shivering fits, which soon rendered those attacked so weak that they could not stand up, but were forced to lie in their beds consumed by violent fever. Soon the boils grew to the size of a walnut, then to that of a hen's egg or a goose's egg, and they were exceedingly painful, and irritated the body, causing the sufferer to vomit blood. The sickness lasted three days, and on the fourth, at the latest, the patient succumbed".

The Italian writer Giovanni Boccaccio wrote graphically about the Black Death in The Decameron. He describes how "More wretched still were the circumstances of the common people and , for a great part, of the middle class, for, confined to their homes either by hope of safety or by poverty, and restricted to their own sections, they fell sick daily by thousands. There, devoid of help, or care, they dies almost without redemption. A great many breathed their last in the public streets, day and night; a large number perished in their homes, and it was only by the stench of their decaying bodies that they proclaimed their death to their neighbors. Everywhere the city was teeming with corpses. "

When the plague first entered an area, mourners of the deceased still prepared coffins and conducted ceremonies for their loved ones. Within weeks, in response to desperation to control the sickness as well as sheer volume of the dead, officials had to resort to mass graves. There was not nearly enough consecrated ground for each victim to have an individual plot, and so enormous trenches were dug into which layer upon layer of dead bodies were lain. The trench was topped off with a small layer of soil, and the morbid process continued. Pope Clement VI even consecrated the entire Rhone river so that corpses could be thrown into it for lack of earth. Those in the peasant class who saw horrors such as these could not accept that a loving God could inflict such a plague upon His people, and considered it to be a punishment from an angry God. Some peasants resorted to magic spells, charms, and talismans. Some people burned incense or other herbs as they believed that they overpowering smell of the dead victims was the source of the disease. Some people even tried to "drive the disease away" with sound from church bells and canon fire. Jews were easy targets for people to blame, and numerous instances of Jew persecution and execution occured. Churchmen, and public officials considered the disease to be just that; a disease. They took measures to quarantine the infection by walling up homes that had members with disease. In Venice and Milan, ships coming in from areas in which disease had been rampant were diverted to separate islands. This action had limited success, but still prevented the disease more than in other areas which did not enforce this type of quarantine. The wealthy were able to leave infected areas and established residence afar. A rather ingenious method of prevention was taken up by pople Clement VI who sat between two large fires at his home in Avignon. Because excess heat destroys bacterium, he was taking the safest, though slightly ludicrous, measures. In the long run, the only "cure" for this epidemic was time, and it seemed, the shortage of new hosts for the disease.

When the Black Death had finally passed out of Western Europe in 1350, the populations of different regions had been reduced greatly. Some villages of Germany were completely wiped out, while other areas of Germany remained virtually untouched. Italy had been hit the hardest by the plague because of the dense population of merchants and active lifestyle within the city states. For example, the city state of Florence was reduced by 1/3 in population within the first six months of infection. By the end, as much as 75% of the population had perished, which left the economy in shambles. Widespread death was not limited to the lower classes. In Avignon, 1/3 of the cardinals were dead. Overall, 25 million people died in just under five years between 1347 and 1352. It is important to realize that the plague had not entirely vanished, only the primary epidemic. Recurrences of bubonic plague occurred every so often and had a traumatic effect on population even then. The plague did not entire vanish as we know it until the late fifteenth century, which allowed for populations to finally begin to rise to the heights that they were at before the Horseman of Death came to Europe.

Historical Significance

The Black Death brought about great change in attitude, culture, and general lifestyle in Europe. A group of individuals known as the Flagellants traveled from town to town beating themselves and inflicting any other punishment that they believed would help atone for the wrongs that they believed had brought about God's wrath. This group was condemned by Pope Clement VI in 1349 and was crushed soon after. The general morbid attitude of the people following the disaster was shown in Tomb engravings. Instead of the traditional engravings of the enclosed being dressed in armor or fine outfits, now carved images of decaying bodies were present. Paintings of the later fourteenth century also demonstrate morbid obsessions of those who had endured the time of the plague. One of the greatest effects of the Black Death was in the realm of laboring classes. The shortage of labor to work land for landowners created opportunity for those living in areas afar as subsistence farmers. They moved to farming communities and along with already present farming peasants, were able to win better working conditions through negotiating and rebelling against landowners. This set Western Europe along the path of diverging classes. The main theme that one can derive from the Black Death is that mortality is ever present, and humanity is fragile, attitudes that are ever present in Western Nations.

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NOAA NCDC National Climatic Data Center
NOAA Paleoclimatology Program, Astronomical Theory of Climate Change

The tilt of the earth relative to its plane of travel about the sun is what causes seasons. The hemisphere "pointing toward" the sun is in summer, while the opposite hemisphere is in winter. The earth makes one full orbit around the sun each year. The northern hemisphere is in summer in the left image, while 6 months later, the southern hemisphere has summer, as in the center image. If the earth's axis were "straight up and down" relative to the orbital plane, as in the right-hand image, there would be no seasons, since any given point at the top of the atmosphere would receive the same amount of sun each day of the year.

Changes in the "tilt" of the earth can change the severity of the seasons - more "tilt" means more severe seasons - warmer summers and colder winters; less "tilt" means less severe seasons - cooler summers and milder winters. The earth wobbles in space so that its tilt changes between about 22 and 25 degrees on a cycle of about 41,000 years. It is the cool summers which are thought to allow snow and ice to last from year to year in high latitudes, eventually building up into massive ice sheets. There are positive feedbacks in the climate system as well, because an earth covered with more snow reflects more of the sun's energy into space, causing additional cooling. In addition, it appears that the amount of Carbon Dioxide in the atmosphere falls as ice sheets grow, also adding to the cooling of the climate.

The earth's orbit around the sun is not quite circular, which means that the earth is slightly closer to the sun at some times of the year than others. The closest approach of the earth to the sun is called perihelion, and it now occurs in January, making northern hemisphere winters slightly milder. This change in timing of perihelion is known as the precession of the equinoxes, and occurs on a period of 22,000 years. 11,000 years ago, perihelion occurred in July, making the seasons more severe than today. The "roundness", or eccentricity, of the earth's orbit varies on cycles of 100,000 and 400,000 years, and this affects how important the timing of perihelion is to the strength of the seasons. The combination of the 41,000 year tilt cycle and the 22,000 year precession cycles, plus the smaller eccentricity signal, affect the relative severity of summer and winter, and are thought to control the growth and retreat of ice sheets. Cool summers in the northern hemisphere, where most of the earth's land mass is located, appear to allow snow and ice to persist to the next winter, allowing the development of large ice sheets over hundreds to thousands of years. Conversely, warmer summers shrink ice sheets by melting more ice than the amount accumulating during the winter.

What is The Milankovitch Theory? The Milankovitch or astronomical theory of climate change is an explanation for changes in the seasons which result from changes in the earth's orbit around the sun. The theory is named for Serbian astronomer Milutin Milankovitch, who calculated the slow changes in the earth's orbit by careful measurements of the position of the stars, and through equations using the gravitational pull of other planets and stars. He determined that the earth "wobbles" in its orbit. The earth's "tilt" is what causes seasons, and changes in the tilt of the earth change the strength of the seasons. The seasons can also be accentuated or modified by the eccentricity (degree of roundness) of the orbital path around the sun, and the precession effect, the position of the solstices in the annual orbit.

What does The Milankovitch Theory say about future climate change?

Orbital changes occur over thousands of years, and the climate system may also take thousands of years to respond to orbital forcing. Theory suggests that the primary driver of ice ages is the total summer radiation received in northern latitude zones where major ice sheets have formed in the past, near 65 degrees north. Past ice ages correlate well to 65N summer insolation (Imbrie 1982). Astronomical calculations show that 65N summer insolation should increase gradually over the next 25,000 years, and that no 65N summer insolation declines sufficient to cause an ice age are expected in the next 50,000 - 100,000 years (Hollan 2000, Berger 2002).

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Recent Calculations of Earth Orbital Parameters and Insolation by A. Berger are archived at the WDC Paleo.
For more detailed explanations of orbital variations with graphic representations, please see WDC Paleo's educational slide set "The Ice Ages".
See also the "Past Cycles: Ice Age Speculations" section of "The Discovery of Global Warming" from the American Institute of Physics for a history of the development of the astronomical theory of climate change.

HAS THE NEW ICE AGE ALREADY BEGUN?
Why "Global Warming" Is A Scientific Hoax
by Laurence Hecht
Printed in The American Almanac, October 13, 1997

Figures and Captions

Text of main article.

U.S. Geological Survey

The Margerie Glacier in Glacier Bay National Monument, Alaska, is a typical fast-moving mountain glacier.

Retreat of the Glacier

The changes wrought in geography during the several-thousand-year period of retreat of the Wisconsin glacier were enormous. It is somewhat shocking to realize that major topographical features on the map of the United States are only about 12,000 years old. Before the completion of the glacial retreat, there were no Great Lakes, for example. None of the many lakes, large and small, that dot the northern tier of the United States existed. Other lakes--such as the 20,000-square mile Lake Bonneville that once covered much of Utah--dried up, leaving behind only a few relatively smaller remnants, like the Great Salt Lake.

The rivers that emerged after the retreat were not the same as those that had been there 100,000 years earlier, before the glaciation. The northern Missouri River, for example, drained northward into Hudson Bay, and what is now the upper Ohio flowed northeast into the Gulf of St. Lawrence. The lower Ohio drained into a now nonexistent river, which geologists have named the Teays.

FIGURE 1 The Earth's Climate over the Last Eight Cycles

FIGURE 2 The Last Glaciation in North America The maximum extent of glaciation occurred just 18,000 years ago and was known in North America as the Wisconsin. The dotted white areas show this huge glacier, which covered the northern area of the continent, and parts of the western mountain ranges. White areas show today's glaciers.

FIGURE 3 Orbital Motion of the Earth Around the Sun

FIGURE 4

Obliquity and Intensity of the Sun's Rays Even without a tilt of the axis, the variation in angle of incidence of the Sun's rays (a) would cause the poles to be cooler. Increasing the angle of obliquity spreads the effect (b).

FIGURE 5 Seasons and Obliquity Seasonal change results from the combined effect of the orbital inclination and the yearly revolution of the Earth around the ellipse. When the Earth's spin axis is pointed away from the pole of the ecliptic, the Northern Hemisphere has its shortest day (winter solstice), while the Southern Hemisphere has its longest day (summer solstice).

FIGURE 6 Precession and Change of Pole Star The Earth's spin axis makes a complete rotation around the pole of the ecliptic in a cycle of approximately 26,000 years. The pole star is now Polaris, but about 13,000 years ago, it was Vega.

FIGURE 7 Precession and Location of the Solstice The precession cycle changes the location on the ellipse where the winter and summer solstices occur. The approximate positions on the ellipse are shown for the solstices today.

FIGURE 8 Advance of the Perihelion or Orbital Precession Perturbations in the Earth's orbit, the result of the motion of the other planets--in particular, Jupiter--cause a phenomenon known as advance of the perihelion or precession of the orbit, in which the complete cycle of procession takes approximately 21,000 years, not 26,000 years.

FIGURE 9 Milankovitch Curves and the Last Glaciation.

Milankovitch calculated variations of the orbital and rotational parameters of the Earth, and climate, over the past 130,000 years, and the next 20,000.

In (a), the obliquity of the ecliptic (solid line), and the eccentricity of the orbit (dashed line) are shown. The dash-dot line gives the variation of the angle between perihelion and the position at vernal equinox, now about 90°, and going from 0 to 360° in about 20,000 years.

The variation of the average daily insolation from the values of the year 1950 is shown in (b), with

1 unit of the vertical scale corresponding to 25 watts per square meter.
Source: Adapted from A. Berger, 1977, Celestial Mechanics, Vol. 15, p. 53, and 1978, Quatenary Research, Vol. 9, p. 139. Reprinted with the permission of Macmillan Publishing Company, a Division of Macmillan, Inc. from Earth and Cosmos by Robert S. Kandel, Copyright 1980.
ARTICLE
"Global Warming" -- Another Name For Population Reduction
The primary purpose behind the global warming scare, is to convince you to accept the necessity of population reduction. There is no scientific evidence behind global warming, as the following article by Laurence Hecht, the first in an occasional series in the New Federalist, will show. This report, which first appeared in 21st Century Science & Technology magazine, Winter 1993-1994, was written shortly before Hecht, an associate editor of 21st Century magazine, began serving a 33-year sentence as a political prisoner in the state of Virginia, along with five other associates of Lyndon LaRouche.
Until the early 1970s, when climate science became ideology-driven, it was generally assumed that long-term astronomical cycles--those measured in tens, or hundreds of thousands of years, and described in this article--were the proper way to situate climate. No scientist who knew these astronomical cycles could be trapped into worrying about the ups and downs of local or global temperatures in time spans of years, or even decades, or be seriously concerned with short-term computer modelling and associated scare stories about global warming.
How then, have we come to a situation where an international climate treaty is on the table, buttressed by a ``consensus'' that contradicts the reality that, based on the last several million years of history, the world is inexorably moving into another Ice Age? We can look to the efforts of a leading Malthusian activist, Dame Margaret Mead, for the answer. Mead chaired a conference in November 1975 on ``The Atmosphere: Endangered or Endangering.'' Scientists who attended that conference warning about a coming Ice Age, such as Stephen Schneider, left the conference promoting global warming.
Mead told the assembled scientists:
``The unparalleled increase in the human population and its demands for food, energy, and resources is clearly the most important destabilizing influence in the biosphere. We are facing a period when society must make decisions on an planetary scale. Unless the peoples of the world can begin to understand the immense and long-term consequences of what appear to be small immediate choices: to drill a well, open a road, build a large airplane, make a nuclear test, install a liquid fast breeder reactor, release chemicals which diffuse throughout the atmosphere, or discharge waste in concentrated amounts into the sea, the whole planet may become endangered. What we need from scientists are estimates, presented with sufficient conservatism and plausibility, that will allow us to start building a system of artificial, but effective warnings, warnings which will parallel the instincts of animals which flee the hurricane....''
Mead went on to say, that the point is to draw from people their capacity for ``sacrifice.'' In other words, scientists should create artificial but plausible stories that will sufficiently scare people, that they will give up their standard of living and modern industrial society--and in the process kill off half or more of the world's population. We are now in an ice age and have been for about the past 2 million years. Over the past 800,000 or so years, the Earth's climate has gone through eight distinct cycles of roughly 100,000-year durations. These cycles are driven by regular periodicities in the eccentricity, tilt, and precession of the Earth's orbit. In each of the past eight cycles, a period of glacial buildup lasting about 80,000 years has ended with a melt, followed by a roughly 10,000-year period--known as an interglacial--in which relatively warm climates prevail over previously ice-covered northern latitudes.
The present interglacial has already lasted beyond the 10,000-year average. One may thus suspect that a new period of glacial advance, a new ``ice age,'' is in the making. Whether it will take a few thousand years or a few hundred, or whether the process of glacial advance is already under way is difficult to say. Of one thing we are sure: The present hysteria over global warming--with its apocalyptic forecast of melting of the polar ice caps, flooding of the coastal cities, and desertification of the world's breadbaskets--is not helping citizens to understand the

real and complex forces that shape the Earth's climate.

We do not wish to counter the global-warming hysterics with a new scare tactic of our own. Those interested in a scare story will have to look elsewhere. Nor will we concern ourselves here with refuting every wild conjecture put forward by the proponents of a global warming. Enough holes have already been poked in this ``theory'' (really only a conjecture) to cause honest scientists to exercise caution. [fn1] Rather, let us take a sober look at the long-term picture of Earth's climate that has been put together over centuries of careful work in the fascinating and challenging multidiscipline science known as paleoclimatology.

Our Present Ice Age

At the present time, glaciers--large, slowly flowing masses of ice formed from recrystallized snow--cover about 6 million of the 57 million or so square miles of land area on the Earth. At the height of an ice age, perhaps another 8 to 12 million square miles of land area, largely in the Northern Hemisphere, becomes covered with a thick layer of ice and crushed snow.

The idea of large-scale glacial motion was brought to the attention of modern science by a Swiss chamois hunter in the early 19th Century, who hypothesized that unusual striations in large exposed rocks had been caused by the pressure of a glacier that had since retreated up the mountain. Louis Agassiz, the Swiss paleontologist and associate of the famous Humboldt brothers, waged the fight to convince the scientific community of the truth of this hypothesis, beginning at a conference of the Swiss Society of Natural Sciences at Neuchatel in 1837.

Northern Hemisphere glaciers have been with us for approximately the past 2 million years, a short stretch on the roughly 4.6 billion-year scale of geologic time, in which our present era, the Cenozoic, occupies the most recent 50 million years. The Cenozoic era is divided into two periods, the Tertiary and Quaternary, the latter of which began about 2 million years ago with the onset of the glacial buildup. Within our present Quaternary period, there are two further subdivisions known as epochs. These are the Pleistocene, which began about 2 million years ago, and the Holocene (or, Recent) epoch, which is roughly 10,000 to 12,000 years old. (Some paleontologists argue quite cogently, that we are still in the Pleistocene and dispense with the designation of a Recent epoch.)

Currently, the greatest area of glaciation is the continental ice sheet of Antarctica (about 5.0 million square miles), which began its expansion about 5 million years ago. The largest Northern Hemisphere glacier is the Greenland ice sheet (about 0.8 million square miles). As the glaciation expands, most of the additional growth takes place in the Northern Hemisphere.

The whole of the last 2 million years, the Quaternary period, is considered an ice age, a relatively rare state of affairs in geologic history. But this long-term ice age has been marked by ebbs and flows in glacial extent. The work of the past two centuries in climatology, paleobiology, meteorology, astronomy, geology, geophysics, and many other fields has confirmed the existence of an astronomically-determined, cyclical pattern within the Quaternary ice age. Driven by well-defined cycles in the Earth's orbital orientation to the Sun, periods of roughly 100,000 years of generally advancing glaciation have been followed by short periods, of roughly 10,000 years' duration, in which the glaciers retreat. These two periods or subdivisions of the ice age are known as glacials and interglacials.

The 100,000-year periods are not one continuous downward slope of temperature and glaciation, but are modulated by roughly 20,000-year cycles, consisting of 10,000 years of cooling and glacial advance followed by 10,000 years of warming and retreat. But these shorter-term ups and downs of the glaciation curve tend to get cooler and cooler as the 100,000-year cycle advances (Figure 1).

The maximum extent of glaciation, the glacial climax of the last 100,000-year ice age, occurred just 18,000 years ago, at a time when human societies were already well established on the Earth. At that time, a huge continental glacier covered North America down through the northeastern states of the United States, reaching across the midwestern plains and up into Canada (Figure 2)). This most recent of the great continental glaciations is known in North America as the Wisconsin (in Europe as the Weichselian). Its southernmost limit extended across the middle of Long Island, through northern New Jersey, lower New York State, western

Pennsylvania, Ohio, Indiana, Illinois, Iowa, then up diagonally through the northeast corner of Nebraska, into the Dakotas, and across the southern tier of the Canadian plains.
In more southerly regions, mountain glaciers also spread downward from heights in the Colorado Rockies, the Sierra Nevadas, and the Cascade Range. In western Europe, the glacier reached down from Scandinavia over northern Germany, Poland, and the Baltic nations. It reached deep into Russia and Ukraine south of Kiev, and eastward as far as the central Siberian Plateau. It stretched southwestward over the Netherlands and covered Ireland and most of the British Isles. A separate portion extended outward from the Alps and another one from the Caucasus Mountains in Asia Minor.
An Arctic climate thus prevailed over much of what are now the major population centers of western and central Europe and the United States. The weather over most of the remaining portions of the three northern continents was quite a bit colder than today's. But hunting was apparently good along the fringes of the continental glaciers, and man survived in these regions in a fairly primitive state, wearing animal furs for warmth and seeking shelter in caves.
Where Are We Now?
We are currently beyond the expected end-point of an interglacial period that began more than 10,000 years ago. We are thus at a point on the paleoclimatic timetable where the onset of a new 100,000-year ice age is expected and may even be already in progress. The global climate has been generally cooling over the past 6,000 to 8,000 years, and is now about 1 degree Fahrenheit cooler than at the time of the postglacial climatic optimum. One might cite evidence such as the advance of the Greenland ice sheet and the southward movement of the line of citrus growing in the southeast United States over the past 40 years to suggest that the expected cooling is even now under way. However, because these astronomically driven cyclical trends are of long duration (10,000 years being the shortest cooling cycle), it is not possible to attribute a climatic trend on a time span so short as a few decades or even a few centuries to a single cause. One must take a broader view.
The melting of the glaciers that had formed during the last 100,000-year ice age cycle took a long time, and the rate of melting was varied, with the North American Laurentide ice sheet being the last to retreat. If we date the beginning of postglacial (interglacial) times to a point roughly 10,000 years ago (c. 8000 B.C.), it is then useful to look at the climate, especially temperature trends, over this recent 10,000 years. Following a number of short-term oscillations beginning about 12,000 B.C., a rise in temperature that set in about 8300 B.C. led to sustained warm climates in the northern European lands formerly covered by ice. The maximum summer temperatures experienced in Europe, over the last 10,000 years, occurred in about 6000 B.C. Over North America, where the process of glacial retreat lagged somewhat, the maximum was reached by about 4000 B.C. That period is known as the Postglacial Climatic Optimum (or the altithermal period), when mean temperatures were about 1 degree Fahrenheit warmer than today.
Beginning about 3500 B.C., a sharp reversal known as the Piora oscillation set in, marked by advance of the glaciers in Europe and large-scale migration of agricultural peoples. From 3000 B.C. to 1000 B.C., the climate regained some of its former warmth but was apparently subject to recurrent fluctuations, particularly in rainfall. From 1000 to 500 B.C., the glaciers advanced again. In Europe the most marked change appears from 1200 B.C. to 700 B.C., coinciding with the Dark Age period that Homeric scholarship suggests occurred in Greek-speaking lands. In some places (Alaska, Chile, China) there is evidence that the cooling and re-advance of the glaciers began as early as 1500 B.C. [fn2]
A period of warmth and higher sea level came to Europe around the year 400 A.D., followed by another reversion to colder and wetter climates. This was again reversed, and there was a very warm period that culminated in Greenland about 900 to 1200 and in Europe 1100 to 1300. Known as the Medieval (or Little) Climatic Optimum, temperatures in this period became, briefly, nearly as warm as in the postglacial climatic optimum. As Lamb describes it: Oats and barley grew in Iceland. The limit of tillage in northern England, Wales, the Scottish highlands, in central Norway, and in high regions of central Europe was extended hundreds of meters up the hills and mountainsides. Mining operations were begun high in the Alps. Norse colonists were catching cod

in the sea off western Greenland, and a regular northern sea route developed to North America. This warming period, which ended as early as 1100 in parts of North America and later in Europe, was followed by a roughly 500-year period of severe cooling known as the Little Ice Age--the Klima-Verschleterung, or climate-worsening in the German literature. The low point of the cooling occurred from about 1550 to 1750, but extreme cold weather began earlier and ended considerably later in many parts. The Greenland colony, for example, died out not long after the year 1400. And in England, tent cities were set up, and Frost Fairs celebrated on the frozen river Thames as late as the winter of 1813-14. Some of the symptoms of the cooling as described by Lamb were:

advance of the inland ice and permafrost in Greenland and of the glaciers in Iceland, Norway, and the Alps;

spread of Arctic sea ice into the north Atlantic agound Greenland, forcing abandonment of the sailing routes used from the year 1000 to 1300;

lowering of the treeline in central European highlands and in the Rockies, spread of lakes and marshes in Europe and northern Russia, swollen rivers and increasing frequency of landslides;

increasing frequency of freezing of rivers and lakes;

increasing severity of windstorms and sea floods;

harvest failures and rising prices of wheat and bread;

abandonment of tillage, vineyards, and farm villages; and

increased incidence of disease and death among human and animal populations.

The Conditions for an Ice Age

From the long-range view of the geologist, the last 2 million years of glacial climate conditions are not the global ``norm.'' Only two times in the 600-million year near-term geologic record have the conditions been ripe for an ice age: once in the Permian period of the Paleozoic era, about 250 million years ago, and once more in the present Quaternary period.

There are two basic requirements for an ice age:

a configuration of the continents that places a large portion of the land mass in polar and extratropical regions,

a climate in the higher latitudes characterized by wet, snowy winters followed by summers cool enough to not reduce the glacial advances made the previous winter.

Although the causes that give rise to these two conditions are complex and far from perfectly understood, the recognition of their importance and of some of the basic mechanisms governing their genesis, dates to no later than the early part of this century. Subsequent advances in nearly all the physical sciences and the work of thousands of researchers in the many fields related to historical climatology have greatly enhanced our understanding and documentation of the climate record. But the big challenge, to understand climate well enough to be able to predict its future course, is still out of reach.

If the name of a single person were to be identified with the birth of the modern science of paleoclimatology, it would be one that is little known, even to many specialists in the field: Vladimir Köppen (1846-1940). The St. Petersburg-born meteorologist came from a German family that had settled in Russia during the reign of Catherine II. He began his study of natural sciences in Heidelberg in 1866 and received his doctorate in 1870 with a paper, published in Moscow, on the effects of heat on plant growth. After a brief period of work at the Central Observatory in St. Petersburg, Köppen came to the German Marine Observatory in Hamburg where he stayed for 44 years, becoming first the head of the weather service and then meteorologist of the observatory.

Köppen's list of publications numbers 526 items. Of these, probably the most important for today is the one he coauthored with his son-in-law, Alfred Wegener, in 1924, Die Klimate der geologischen Vorzeit (The Climates of the Geological Past). Alfred Wegener (1880-1930) is known to students of the earth sciences today as the father of the modern theory of continental drift. Wegener's now-famous theory was initially rejected by the science establishment, and became widely accepted only in the 1960s and 1970s, well after his tragic death on the Greenland glacier in 1930.

A Common Thread

It is somewhat less well known that Wegener and his father-in-law Köppen were also leading proponents of the modern theory of astronomical determination of the ice age cycles.

The two theories--continental drift and the determination of the ice ages by the cycle of solar insolation (the radiation experienced at the edge of the Earth's atmosphere)--had a common thread. In the minds of Wegener and Köppen they were really one grand conception. The first notion began with Wegener no later than 1910. It is recorded in a charming letter to his wife:

``Doesn't the east coast of South America fit exactly against the west coast of Africa, as if they had once been joined? The fit is even better if you look at a map of the floor of the Atlantic and compare the edges of the dropoff into the ocean basin rather than the current edges of the continents. This is an idea I'll have to pursue.'' [fn3]

The idea itself was not new; it had been noted in Alexander von Humboldt's famous Cosmos, among other locations.

But Wegener had at his command the extensive researches of the previous century, which included data of both a geologic and paleobiologic sort, suggesting the possiblity that the continents had once been linked. The similarity of South American and African fossils and the close relationship of flora and fauna of many regions separated by oceans had already been noticed by investigators. One prominent attempt at an explanation was the hypothesis that land bridges had once existed, for example, connecting South Africa with southern South America, North Africa with Florida and the Caribbean, and so forth. Twenty years before Wegener, the great Viennese geologist Eduard Suess had proposed that the continents may have been linked together in one supercontinent, which he called Gondwanaland. The similarity in geological development of the continents of the Southern Hemisphere (including the Indian subcontinent), and their marked difference from those of the north, had already suggested some such link. But Suess was not sufficiently versed in these fields to recognize the paleobiological and climatological significance of his hypothesis.

Wegener drew on Suess's differentiation of the two major types of rocks sial (for silicon-alumina) and sima (for silicon-magnesia) that make up, respectively, the bulk of the crustal material of the continents and the ocean floors. The sial, which corresponds most closely to granite, has a specific gravity (a measure of its weight in comparison to an equivalent volume of water) of 2.7, while the sima, which is like basalt, is somewhat heavier at 3.0. Thus the lighter rock making up the continental crust could be thought of as giant blocks, floating somewhat like icebergs above the denser sima.

Wegener's hypothesis was first presented in Frankfurt-am-Main on Jan. 6, 1912, at the annual meeting of the Geological Association. The first book-length account, Die Enstehung der Kontinente und Ozeane (The Origin of the Continents and Oceans), appeared in 1915. Here and in his other early papers, Wegener was somewhat at a loss to explain by what mechanism the drifting apart of these blocks would occur. In 1929, he tentatively proposed the means by which the drift is today understood to occur, referring to the possibility of convection currents in the magma--the layer of molten rock on which the Earth's crust is thought to float. The high mountain ranges found near the edge of continents--the Alps, Himalayas, and the Cordilleras, which range from Alaska to southern Chile--were seen as produced by the crumpling up of layers of rock on the leading edge of the drifting continents, produced by forces similar to that of a bow wave. [fn4]

Together, these ideas condensed in the notion that the continental blocks had once been united in a single great continent, called Pangaea, and had subsequently drifted apart, taking up various configurations before arriving at the one we know today. In its details, the Wegener hypothesis also went a long way toward explaining some of the climatic anomalies in the fossil record and other paleobiologic evidence from widely varying places on the Earth. According to the modern reconstruction of the theory of drifting continents, only in the Permian period (250 million years ago), and the present Quaternary, does the placement of the continental land masses in the higher latitudes, allow for the buildup of the great glacial ice sheets.

The Solar Astronomical Cycles

In 1910, the same year that Wegener was formulating the theory of continental drift, his

father-in-law, Köppen, was musing over the earlier research work of Albrecht Penck (1858-1945) and Eduard Brückner (1862-1927), Die Alpen in Eiszeitalter (The Alps in the Ice Age). Through their extensive fieldwork in Alpine regions, Penck and Brückner had been able to distinguish four separate cycles of glacial advance and retreat over the ages, and they produced a climatic curve for the ice age. Köppen conceived the idea of essentially overlaying on this curve the time-scale produced by examining the changes in solar radiation caused by regular cycles in the Earth's orbital relationship to the Sun. Köppen's hope was that the cycles of glacial advance and retreat could be dated by correlating them to the astronomical cycles.

The idea of a correlation between long-term changes in climate and the solar-astronomical cycles goes back to a hypothesis put forth in 1830 by Sir John Herschel, the son of the great astronomer Friedrich Wilhelm Herschel and a leading figure in 19th-Century British science. Herschel thought that the 21,000-year cycle of seasonal precession of the equinox might have a determining effect on climatic history. His hypothesis was taken up and elaborated first by the French mathematician J.F. Adhémar in 1842, and then, by the self-taught Scottish climatologist James Croll, beginning in 1860, who added into his calculations the cycle of change of the eccentricity of the orbit. However, at the end of the 19th Century, the exact periodicity and extent of this cyclical variable had not been precisely calculated. Croll was also hampered by his incorrect supposition that periods of ice buildup would coincide with the harshest winters.

It has since been deduced, that mild summers, in which the glacial advance of the previous winter's snow is not erased, are more important than the harshness of winter. Nevertheless, against great opposition, Croll defended the hypothesis first advanced by Herschel into the end of the 19th century. In 1910, when Köppen and then Wegener took it up again, it was neither a popular nor a widely accepted hypothesis.

But one man, Milutin Milankovitch (1879-1958), a skilled mathematician from the University of Belgrade, had independently begun his own investigation of the astronomical theory of climate. From 1911 until his first contact with Köppen in 1920, Milankovitch carried out painstaking calculations of the long curve of the variability of solar insolation (the amount of sunlight) at northern latitudes, in hopes of demonstrating its forcing effect on the ice age cycles. He published a few small papers on his work and then, in 1920, a book in the French language, The Mathematical Theory of Heat Phenomena Produced by Solar Radiation, which came to the attention of Köppen.

In that work, Milankovitch spelled out his theory of astronomical rhythms, carefully determining the effect of three major cyclical variables:

the 26,000-year period of the precession of the equinox, which, when combined with the advance of the perihelion, the point at which the Earth is closest to the Sun (perihelion precession), produces a 21,000-year cycle;

the 40,000-year cycle of variation of the obliquity of the ecliptic (the angle of the Earth's axis), which varies from 22 to 24.5 degrees;

the 90,000 to 100,000-year cycle of variation of the eccentricity of the Earth's elliptical orbit.

A postcard from Köppen initiated an extended correspondence between the two men. Milankovitch, who hoped to use his calculations to produce a curve of past climates, was troubled by the question of which season and which latitude was most critical to the advance of glaciation. One of the important fruits of the exchange was Köppen's conclusion that it is the diminution of summer heat--not the increase of winter coldness, as Croll had thought--that is most important to the ice buildup.

At the encouragement of Köppen, Milankovitch calculated the effect of the three astronomical cycles on Northern Hemisphere glaciation for 650,000 years into the past and 160,000 years into the future. This came to be known as the Milankovitch-cycle theory of climatic history. In a popular book published in Leipzig in 1936, Milankovitch described his theory and his close collaboration with Köppen and Wegener in the form of letters to an imaginary girlfriend, Durch Ferne Welten und Zeiten, (Through Distant Worlds and Times: Letters from an Ambler through the Universe). [fn5]

Like Wegener's theory of continental drift, the Milankovitch theory of astronomical cycles was not

widely accepted by the scientific establishment. Nevertheless, a number of paleoclimatologists in America and Europe took it up and carried out pioneering work from the 1930s onward, which tended to corroborate the Milankovitch cycles. Much of this was in the field of paleobiology, examining core samples from various marine basins under the microscope, using innovative means of dating the biota and determining sea levels and temperature levels coinciding with the time of their formation.

Although Milankovitch was still fighting an uphill battle at the time of his death in 1958, today his general theory is widely accepted. Deep-sea core samples taken in the 1970s showed the Milankovitch 20,000, 40,000, and 100,000-year periodicities going back for 1.7 million years. The new work was reported in Science magazine in 1976 in a paper written by a team of researchers at Columbia University's Lamont-Doherty Geological Laboratory. [fn6] Somewhat ironically, the geology department at that university had been one of the staunchest holdouts against Wegener's theory of continental drift.

Dr. John Imbrie, who ran the computer programs analyzing the data, was the first to hypothesize that the evident periodicity was the Milankovitch cycles, which found that the 100,000-year cycle was predominant. (Milankovitch had expected that the 40,000-year cycle of the angle of obliquity would be the dominant one; it was for the periods before about 800,000 years ago. But since that time, for reasons not yet fully understood, the 100,000-year periodicity became dominant.)

The Solar Cycles

To understand the solar astronomical cycles, which are one of the foundations of the scientific theory of climate history, we need only examine some of the key geometric features of the Earth's elliptical orbit. Johannes Kepler's discovery in the early 17th Century, that the planets move in ellipses about the Sun, with the Sun at one focus, and his elaboration of the laws of this motion are the basis of all astronomical hypothesis concerning climate. (Nor can it be accidental that Wegener had studied classical astronomy and wrote his dissertation at the University of Berlin on the subject ``The Alphonsine Tables for the Use of a Modern Calculator,'' a recalculation of the old tables used to ascertain the positions of the Sun, Moon, and the five then-known planets.)

Let PQ'AQ represent the elliptical orbit of the Earth around the Sun at S (Figure 3). Looking down upon the North Pole of the Earth, the orbital motion is counter-clockwise from P to Q'A, to A to Q and back to P again. We have exaggerated the ellipse in order to simplify visualization of the processes described. As the Sun sits at one focus of the ellipse, the distance from Earth to Sun is least when the Earth is at P, the position known as perihelion, and greatest at A, the aphelion. Let us examine the change in the amount of solar radiation that will be felt as the Earth moves from aphelion to perihelion.

An ellipse is completely described by two parameters, the length of its semimajor axis, a, and the value of the eccentricty, e, which is the factor by which a is multiplied to find the foci. Measuring from the center of the ellipse (where the semimajor and semiminor axes cross), a focus is located at a distance ae along the semimajor axis. The eccentricity e is thus always a number between 0 and 1.

With this in mind, we see that the perihelion point, P, sits at a distance (a - ae) from the Sun while the aphelion, A, is at the distance (a + ae).

Now, since the intensity of light varies as the inverse square of the distance from the source, we can calculate the maximum variation of insolation between perihelion and aphelion, and the value 4e provides a very good approximation for this flux difference.*

The present value of eccentricity for the Earth's orbit is 0.017, and the variation in insolation thus comes to 0.068, or approximately 7 percent. But the orbital eccentricity is known to pass through a complete cycle in approximately 94,000 years, varying from near 0 (a circular orbit) to 0.07. At the latter value, the difference in insolation between aphelion and perihelion becomes 28 percent.

Now, the Earth is not simply a moving point, but a solid body of more or less spherical shape. It rotates about an axis that is inclined to the plane of the ellipse by a certain angle known as the angle of obliquity. It is this inclination of the Earth's axis, which is now about 23.5 degrees, that causes the main difference in temperature between polar and equatorial regions. The Sun's rays striking the Earth obliquely are forced to pass through a much greater thickness of atmosphere,

thus dissipating their warming effect, than those rays that strike in a more perpendicular direction and are thus required to penetrate a lesser amount of the atmosphere. Even without that obliquity there would be some variation in temperature between pole and equator, because of the changing angle at which the parallel rays of the Sun will strike the circular arc that represents the Earth's surface (Figure 4). An increase in the angle of obliquity tends to exacerbate this effect.
Seasonal change, that is the yearly passage from spring-summer-fall-winter, is caused by the combined effect of the orbital inclination and the yearly revolution of the Earth around the ellipse. In the course of a year, the Earth's axis of rotation will point to the same approximate direction in the distant sky, no matter where on the ellipse we find ourselves (Figure 5). However, in one annual revolution around the Sun, the axis will take up all orientations with respect to the line perpendicular to the plane of the ellipse and passing through the center of the Sun, which is known as the pole of the ecliptic. When the Earth's spin axis is pointed 180 degrees away from the pole of the ecliptic (looking down on the ellipse from the direction of the North Pole), the Northern Hemisphere experiences its shortest day, known as the winter solstice. On the same day, the Southern Hemisphere experiences its longest day, the summer solstice. The opposite situation would arise at the position 180 degrees around the ellipse.
If the axis of the Earth had no motion of its own, the seasons would always occur at the same points in the orbit. But the direction in the sky, to which the Earth's axis of rotation points, varies on a cycle of approximately 26,000 years. In the course of that cycle, the spin axis makes a complete rotation around the pole of the ecliptic, one obvious consequence of which is a change in the pole star (Figure 6). Another consequence, which was noted by the ancient astronomers, was the long-period change in that constellation in which they observed the Sun rising on the day of the vernal (spring) equinox. Later comparison of the physical dynamics of this phenomenon to the precession of a spinning top (the wobbling as it winds down) led to the name precession of the equinox for the 26,000-year cycle.
As a result of this phenomenon, we must take into account where on the ellipse the winter and summer solstices occur. When the Earth is at P in Figure 6 and the axis is turned 180 degrees away from the Sun, we will have winter in the Northern Hemisphere. That was the situation in approximately the year 1250. Today we have moved a bit on the precession cycle and find the Northern Hemisphere winter occurring at roughly the position shown in (Figure 7).
In addition to the phenomenon known as precession of the equinox, the perturbations in the Earth's orbit caused by the motion of the other planets, most notably Jupiter, cause a phenomenon known as precession of the orbit, or advance of the perihelion. The result is that the complete cycle of return to the position where Northern Hemisphere winter occurs at P takes approximately 21,000, not 26,000, years (Figure 8).
Recalling that the most important astronomical requirement for glacial advance is a string of mild summers in which the winter snow buildup is not completely erased by melt, we are now in a position to examine how the orientations of the orbit might contribute to meeting this need. It might at first appear that the occurrence of Northern Hemisphere summer at A, combined with a relatively high eccentricity, would produce the most favorable conditions.
However, we have yet to take one other consideration into account. The rate of motion of the Earth in its elliptical orbit is not uniform. As Kepler was able to demonstrate, the planets move more swiftly when near to the Sun at position P than when at position A. It turns out that, although the planet will receive exactly the same insolation in all four quadrants, the same insolation is received over a longer number of days in the two larger quadrants, and its flux density per day is consequently less.*
If winter solstice occurs at P, climatologists call the two smaller quadrants caloric winter and the two larger ones caloric summer. One sees then that another way of describing the condition described above is to say that the summer is longer and milder (at least with respect to solar insolation) than winter. The difference in length between caloric summer and winter can be as great as 33 days. At the present time, the difference is 7 days. This will vary with the eccentricity, which, as we have mentioned, has a cycle of about 94,000 years.
As the position of the winter solstice moves around the ellipse, a pair of perpendicular lines drawn

through the Sun will always describe the four seasonal positions. Thus it can be seen that a cycle of 21,000 years duration will be superimposed on the longer cycle of 94,000 years duration. Let us suppose, for example, that we begin at a point in time when the winter solstice is at P and the orbital eccentricity is at a maximum. The greatest excess in the number of days of caloric summer over winter will then be experienced, and consequently the lowest flux density of the summer insolation. Assuming the proper meteorological dynamics, this should be an ideal position for the rapid advance of glaciation.

Let the rotational axis then move through one-half of its 21,000-year cycle of seasonal precession--10,500 years--bringing us to the position where the winter solstice is occurring at A. As the eccentricity will have lessened by only about one-fifth of its greatest value in this position (its cycle of change is not perfectly linear), the Earth will now experience a most intense daily flux of solar radiation during the relatively brief caloric summer, creating ideal conditions for glacial melt. The winter, however, will be longer and colder than normal insofar as the solar flux affects it. The outcome is perhaps a toss-up. Half a precessional cycle later, winter solstice occurs again at P and the eccentricity is still relatively great. Conditions for glacial advance are again good.

It will only rarely be the case, however, that the ideal situation should occur, in which the maximum of eccentricity and a winter solstice at P take place simultaneously. Further, a third cycle, the one that Milankovitch thought primary, must be considered--the variation in the angle of obliquity over a 40,000-year period. When these added considerations are taken into account, a curve can be derived of the sort illustrated for various latitudes in (Figure 9). The close relationship between the variations of average daily insolation and the estimated variation in average temperature during the last 100,000-year-plus ice age cycle is seen.

Notes

See 21st Century Science & Technology, Winter 1993-1994, pp. 23-35, for full explanation and calcuation.

See, for example, Hugh W. Ellsaesser, ``Setting the 10,000-year Climate Record Straight,'' 21st Century, Winter 1991, p. 52; and Dixy Lee Ray, ``Scientific Evidence Vs. Climate Hoaxes: Greenhouse Earth,'' 21st Century, Winter 1990, p. 28.

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