HISTORY OF EARTH REMAINS SHROUDED IN MYSTERY

Earth has existed for billions of years in a variety of changing forms

our world appears to have begun as a fiery ball

this condition would have been permanent except for the effects of air surrounding the planet

air is responsible for most of the changes on the earth's surface

unimaginable changes have occurred on the surface of the Earth during its existence

truly remarkable animals have populated the planet, sometimes for vast amounts of time,

and have died out -- only a select few animals, fish, insects and organism have survived

humans occupied the planet very late in the Earth's history

GEOLOGIC TIME IS INCOMPREHENDIBLE

In an effort to understand the vast amounts of time and enormous changes during Earth's history

scientists have developed a timeline composed of two **"Eons"**

"**Pre-Cambrian Eon"** and the **"Phanerozoic Eon"** are the largest division of geologic time

Eons are further divided into **"Eras," "Periods" and "Epochs"**

each time interval is marked by a relatively abrupt change in fossil types and numbers

length of time attributed to each Era, Period and Epoch is, of course, approximate

(and sometimes are simply wild guesses)

Pre-Cambrian Eon is composed of three "Eras"

**"Pre-Archean"** or **"Hadean Era;" Archeozoic** or **"Archean Era;"**

and **"Proterozoic Era"**

each of these is further divided into Periods and Epochs

Phanerozoic Eon is divided into three "Eras" and reaches to the present

"**Paleozoic Era," "Mesozoic Era" and "Cenozoic Era"**

each of these is further divided into Periods and Epochs

To grasp the unimaginable amounts of time required to develop the earth as we know it today

it is sometimes convenient to think in terms of a twenty-four clock

with vast amount of time compared to each hour on that clock

representation of time on our twenty-four clock varies by author

but usually not by significant amounts in relation to 4.6 billion years

**"PRECAMBRIAN PERIOD**" -- THE OLDEST KNOWN PORTION OF GEOLOGIC TIME

**"Precambrian Period"** lasted from about 4.6 billion years ago to about 540 million years ago

this is about ninety percent of the time the planet has existed, or about 4.5 billion years

using our proposed twenty-four clock to represent the vast amounts of time in Earth's history

this era would be depicted as lasting from midnight to about 9:18 P.M.

or lasting more that twenty-one of the twenty-four hours

during much of this era Earth remained in a molten (liquid) form
with the exception of zircons dating back 4.4 billion years there was not even rock
Over billions of years the earth's surface cooled enough to form a solid crust
water in the form of steam cooled and formed ponds, lakes and oceans in basins of cooled Earth
cracks developed in the cool rock allowing water to enter and freeze and thaw
surface of the planet was formed and reformed many times over these billions of years
it was a time of great volcanic activity and mountain building
first single-cell organisms came into existence after about 2.3 billion years
first multi-cell organisms come into existence toward the close of the Precambrian Era
Very little is known about the climate during the Precambrian Era
but the Earth was driven into a very cold glacial age at the end of the era

PHANEROZOIC EON ENCOMPASSES ALL OF THE REST OF TIME

Phanerozoic Eon is divided into three Eras: **"Paleozoic Era," "Mesozoic Era"** and **"Cenozoic Era"**
there is enough fossil material to further divide the Paleozoic Era into six identifiable **"Periods"**
Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian
each of these is again divided into **"Epochs"**

**"Paleozoic Era"** lasted from about 540 million years ago to some 230 million years ago
or from 9:18 P.M. to 9: 57 P.M. on the twenty-four-hour clock
there is enough fossil material to further divide the Paleozoic Era into identifiable **"Periods"**

**"Cambrian Period"** of the Paleozoic Era
lasted from about 540 million years ago to 490 million years ago
sea weed floated on an endless ocean of saltwater in the mild climate
**"Cambrian Explosion"** of life occurred
fossil records show life existed in the ocean waters on the Earth's surface
these creatures eventually developed shells resembling clams or cockles
and gave rise to the development of sea life lacking a backbone
these invertebrates provided the only living existence on earth
**"sedimentary"** rock was formed by deposits that settled at the bottom of the ocean
weight of mud and pressure from shifting earth compressed the material into solid form
chemical action further fused this material together
shells of organic (living) material also was deposited and formed into rock
limestone and shale are common sedimentary rocks of this type

"**Ordovician Period"** lasted from about 490 million years ago to approximately 440 million years ago
primitive fish and fungi developed as the first complex life-forms
land first emerged slightly above the world of water
molten **("igneous")** rock from the Earth's interior was forced upward by heat and pressure

lifting the sedimentary rock upwards through the surrounding water
mountain ranges were formed by igneous rock lifting sedimentary rock
volcanoes ejected lava, pumice (volcanic glass) and ash
during these great uplifts seas were drained and left sedimentary and igneous rock exposed
high sea levels fell as the earth cooled as ice formed in the Arctic and Antarctic regions
primitive plants appeared on the land
this period ended with huge glaciers formed as great flows of ice grew in size
extinction wiped out many plant and animal species

"**Silurian Period"** lasted from about 440 million years ago to about 417 million years ago
first plants capable of conducting water (as compared to mosses) appeared on the land
high sea levels existed worldwide leading to the rise of hinged-shelled species and corals
starfish-like and sea urchin-like creatures appeared
first jawed fishes and insects like centipedes and millipedes appeared as shown by fossils
fish life dominated the planet

"**Devonian Period"** lasted from about 417 million years ago to about 354 million years ago
this was the **"Age of Fishes"** as fish and land plants become abundant and diverse
sharks and water vertebrates emerged on the earth
new insects also made an appearance
air breathing animals appeared on dry land
mass extinction at the end of the era wiped out 30% of all animal families
probably due to an increase in the size and number of glaciers
or the impact of a meteorite striking the Earth

"**Mississippian Period"** lasted from about 354 million years ago to about 323 million years ago
much of North American was elevated above the primal sea as winged insects come into existence
this was the age of amphibians that developed into great abundance
and the first reptiles came into existence
first forests spread across the planet
coal developed from decayed plant life subjected to vast amounts of heat and pressure
Pacific coast made its first appearance during this coastal **"First Geologic Age"**
land composed of two granite islands began to rise up from depths of the sea
one island known as Siskiyou Island was in the region of today's Siskiyou Mountains
located three hundred miles east of today's coastline
in Northern California and Southern Oregon
another region, known as Shoshone Island, was in the heart of today's Blue Mountains
of southeast Washington and northeast Oregon
both Shoshone and Siskiyou islands were thrust up far into the ocean cut off from the continent
fossils from this period were tropical life forms that were washed by warm seas

these left a record of ancient beach levels
ancient coast line was thus two island groups
an immense bay was created on Shoshone Island high in the Blue Mountains
streams brought down massive mineral deposits of silt and sands
that reached a thickness of many thousands of feet deep on the ocean floor
these massive deposits gradually hardened into sedimentary rocks
such as limestone, sandstone and shale
magnetite mineral veins in today's Stevens Country were formed by heat and pressure
from calcium and magnesium salts located on the ocean floor
seismic disturbances such as earthquakes and volcanic eruptions were so violent
that old sedimentary rock of the ocean bed was sometimes changed to **"metamorphic"** rock
by heat and pressure
for example marble could be transformed from limestone and slate from shale
at about the same time a period of uplifts took place as the continent slowly rose and expanded
in response to pressure from the shrinking crust of the Earth
rocks were massed and folded together -- ground level was elevated and water receded
what had been the bottom of the sea now became dry land
vast barrier of pinnacled peaks composed of the Okanogan Uplift and Chelan Uplift appeared
granite and porphyry (reddish purple rock) broken by flows of volcanic lava
was veined with gold, silver and copper

"**Pennsylvanian Period"** lasted from about 323 million years ago to about 290 million years ago
this was the age of large winged insects and amphibians which flourished
land of the Pacific Northwest saw alternating periods of flooding and drying
silt carried by the many rivers eventually filled in the bays
which had been thousands of feet deep in places
rocks such as schist, marble, slate and quartzite were formed
masses of melted rock fused with sliver, gold and other metals
were thrust upward through the earth's crust

"**Permian Period"** lasted from about 290 million years ago to about 230 million years ago
reptiles and amphibians developed as a life form in the Northwest
this **"Second Geologic Age"** for today's Pacific coast was the **"Age of Volcanoes"**
uplifting of the Blue Mountains and Cascade Mountains from the ocean floor ended
as the Earth's crust cooled and shrank
lava floods rose up from fissures and vents in the Earth which formed all over the region
molten glassy or porous lava, cinders or ash welled up and forcibly spewed out
from these cracks in the Earth's surface becoming sheets that cooled into rock
land formations were blown apart by volcanic eruption and seismic forces

vast outflows of shiny, black volcanic basalt and gray fine-grained andesitic rock
swept westward from the Blue Mountains to meet similar flows
moving eastward from Cascade Mountains
these molten masses, called magma, cooled slowly and hardened
frequently the fiery floods of molten rock transformed original rocks
into various metamorphic forms of gneiss, porphyry and marble

greatest result of the Age of Volcanoes was the elevation of stupendous isolated peaks
cooling lava, cinders and ash built up enormous peaks such as
Mount Rainier, Mount Baker, Mount Adams, Mount St. Helens, Glacier Peak, Goat Rocks,
Silver Star Mountain and West Crater in Washington's Cascade Mountain Range
Mount Olympus, Mount Constance, Mount Anderson, The Brothers (double peaked),
Mount Deception, Mount Angeles, Boulder Peak and Mount Storm King
in the Olympic Mountain Ranger appear to be no longer active
sometimes intervals of centuries stretched between lava flows

one of greatest lava flows of all time inundated a large part of Eastern Washington
Columbia River basalt, one the largest bodies of lava in the world,
covered a great part of Washington and Snake River plain in Idaho, eastern Oregon
and much of Northern California -- 250,000 square miles
in some places lava flowed over a mile deep
mountain chains were in place with the close of volcanic age
but plains and valleys visible today were not yet fashioned

five regions of Washington State came into existence during the Permian Period:

•Olympic Peninsula of the Pacific coast was composed of a narrow plain
with the towering Olympic Mountains in the north and the Willapa Hills to the south
Mount Olympus (8,150 foot) is surrounded by jumble of jagged peaks
Willapa Hills, built of softer materials, are now much lower
as they have worn down rather rapidly
numerous lakes, glaciers and rivers occur today in the region
glaciers have cut deeply into the Olympic Mountains
some remnants of old deposits still can be seen in higher elevations
heaviest rainfall in the continental United States occurs here
and the heaviest rainfall in Washington State occurs at Grays Harbor and Willapa Bay
and in the dark rain forests of the Olympic Peninsula
this is one of the most heavily forested regions of North America
dense growths of spruce, fir, cedar and hemlock cover the region
and display almost impenetrable undergrowth

•Puget Sound Lowland represents only about five percent of the area of the state

it runs from the Canadian border on the north to the Columbia River on the south
Puget Sound, gouged by glaciers from various **"Ice Ages,"** is the heart of the region
eons ago the region had been uplifted above surrounding lands to the east and to the west
but being composed of softer rock it was easily eroded by wind, rain and frost
here are excellent harbors and great forests of cedar, hemlock, spruce and Douglas fir
many important rivers are located in the region
Cowlitz River flows into the Columbia River at today's Kelso and Longview
Chehalis River flows west emptying into Grays Harbor at Aberdeen
Carbon Rivers enter the Puyallup River at Orting as does the White River at Sumner
Puyallup, Nisqually, Snohomish, Skagit, Nooksack rivers empty into Puget Sound
of these, the Snohomish River the largest in volume

•Cascade Mountain Range spans north and south in a series of earth folds
they have a foundation of granite, volcanic and sedimentary rock
at the Canadian border these mountains spread east and west for one hundred twenty miles
while the Columbia River carved a spectacular gorge through sixty miles of mountains
Cascades create two separate climate zones in the State of Washington
its western slopes receive the most rainfall from the Pacific Ocean
eastern slopes experience drought as the mountains cut off the Pacific's moisture
many important rivers in Washington have their source in the Cascade Mountains
several have been harnessed to generate electric power
Cowlitz, Lewis, Skagit, Snoqualmie and White rivers
elevations in the Cascades vary from lofty peaks to low passes
four peaks are active volcanoes in Washington:
-Mount Rainier (14,408' but 2,000' blew off leaving a crater two miles wide)
two cinder cones rose to form the present summit;
-Mount Adams (12,307');
-Mount Baker (10,730');
-Mount St. Helens (9,697' before the 1980 eruption it is now 8,366 feet high)
most well known of the Cascade Mountain passes across the Cascade Mountains are:
-Rainy Pass (4,855 ft.) on State Route Highway 20;
-Washington Pass (5,477 ft.) on State Highway 20;
-Stevens Pass (4,061 ft.) on U.S. Highway 2;
-Snoqualmie Pass (3,022 ft.) on U.S. Interstate Highway 405;
-Cayuse Pass (4,675 ft.) on State Route Highway 410 and U.S. Highway 12;
-Chinook Pass (5,430 ft.) on State Route Highways 410;
-White Pass (4,500 ft.) on U.S. Highway Highways 12;
Blewett Pass, formerly known as Swauk Pass, (4,124 feet) U.S. Highway 97

runs north and south along the spine of the mountain range
it links Wenatchee, Washington in the north to Ellensburg on the south

•Columbia River Basin also known as the Columbia Plateau
occupies more than one-fourth of the area of the state
from the Cascade Mountains to Spokane, Washington
Columbia Basin is surrounded by mountains and uplands:
-east are the Rocky Mountains,
-south are the Blue Mountains and Horse Heaven Hills,
-west are the Cascade Mountains,
-north are the Okanogan Highlands and Selkirk Range
saucer shaped Columbia Basin was a broken country with lakes and wooded mountains
before lava flows took place and volcanic basalt rock poured into the mold
today ancient mountain summits still remain as hills
volcanic rock covers much of the shattered fragments of the Earth's original crust
however, in many places primeval granite or sandstone remains uncovered
to the north the Waterville Plateau drops one thousand feet to form the Quincy Basin
which extends up the Okanogan Valley to Omak, Washington
at the southern end of the Columbia Basin is the Pasco Basin
eastward is the Palouse Country where the Palouse Hill were built up from loess
yellow-brown sediment mixed with volcanic ash
winds have formed the fertile loess into long dunes
Steptoe Butte, formed of prehistoric crystalline rock rises 1,200 feet above bedrock
more than 3,600 feet above sea level
Columbia Basin today is known for wheat lands, irrigated farms, orchards
and electric power projects

•Okanogan Highlands extend across northern Eastern Washington into Canada
lava flows did not invade this region which today is composed of
a great deal of older basalt rock and granite
some of the oldest rock in the state is found here
these include schist, and ancient granite all formed millions of years ago
there is an abundance of minerals such as: gold, silver, copper, lead, zinc,
and some tungsten and uranium
Okanogan Highlands are noted for their long north-south trench valleys
with rivers that have cut deep canyons down the center
best known of these rivers are:
-Colville and Pend d'Oreille rivers which flow to the north
-Columbia, Okanogan, and San Poil rivers which flow south

-Kettle and Methow rivers which flow southeast

these river valleys are ideal for farming, dairying, stock-raising and fruit-growing

Permian Period ended with the largest mass extinction as yet known

fifty percent of all animal families, ninety-five percent of all marine species and many trees became extinct perhaps because of glaciations or volcanic activity

**"MESOZOIC ERA"** IS THE FIRST EXPANSE OF TIME OF THE PHANEROZOIC EON

This **"Third Geologic Age"** in the Pacific Northwest was a time of flooding and drying

Mesozoic Era lasted from about 230 million years ago to some 60 million years ago

or from about 9: 57 P.M. to about 10:57 P.M. on the twenty-four-hour clock

this was known as the **"Age of Reptiles"**

*Triassic Period* lasted from about 230 million years ago to approximately 200 million years ago

during this period mollusks were the dominant invertebrates on Earth

many reptiles, for example, turtles came into existence as did insects such as flies

animal life became more diversified as the first dinosaurs and mammals appeared on the Earth

Northwest was flooded and dried several times during this period

upheavals of mingled granite and volcanic masses took place

in the Cascades, Blue Mountains and Rockies

this process imprisoned a vast sea over today's Eastern Washington

deposits of sediment were formed hundreds and thousands of feet in depth

Yakima, Walla Walla and Spokane rivers formed smooth valleys and lesser streams

similar processes fashioned the valleys of the Willamette River and other streams

between the Cascades and the Coastal Mountains to the west

Triassic period ended with a minor extinction that allowed dinosaurs to expand their range

*Jurassic Period* lasted from about 200 million years ago to approximately 145 million years ago

flesh-eating and plant-eating dinosaurs ranged over vast areas of the planet

formerly cold climate turned mild and humid

birds and flowering plants made their first appearance

*Cretaceous Period* lasted from about 145 million years ago to approximately 60 million years ago

this is the **"Age of Dinosaurs"**

first feathered dinosaurs and crocodile-like creatures appeared as did the earliest-known butterflies and the earliest-known snakes, ants and bees

this is the period of greatest flooding in the Pacific Northwest

**"CENOZOIC ERA"** IS THE SECOND EXPANSE OF TIME OF THE PHANEROZOIC EON

Cenozoic Era lasted from about 60 million years ago to approximately 1.8 million years ago

or from about 11:52 P.M. to about 11:59 P.M. on the twenty-four-hour clock

vast climate changes took place around the globe over the millions of years
global warming events alternated with ice ages
*Tertiary Period* lasted from about 60 million to the neighborhood of 30 million years ago
North America roughly took shape as general erosion altered the landscape
grasses were in abundance on the land
this vegetation was subtropical in the then-low Cascade Mountains
this period saw the first large mammals and primitive primates
sediment in the lake bottoms accumulated at a rate of a fraction of an inch a year
and over vast amounts of time reached a thickness of 3,000 feet in places
a record of subtropical plant life on lake bottoms was left as fossils
these marshy Cascade Mountain lakes became beds of coal
Rocky Mountains were elevated to a height which created great snow fields
and continued to rise by volcanic and folding action
Cascade Mountains saw extensive volcanic activity which elevated these mountains
many layers of lava flows have been counted
after the seventh lava flow from the top had cooled, many feet of soil accumulated
sufficient time elapsed for trees six feet in diameter to grow
sixth flow of lava from the top buried this forest -- fossil trees may still be seen
Cascades became high enough to block rain carried inland from the ocean
Eastern Washington developed an arid climate and was slowly changed into a system
of great fresh-water lakes that became the Columbia River and its tributaries
bed of the Columbia River through the mountains
had already eroded to a depth of 900 feet
extensive volcanic ash and sedimentation covered Washington State
streams of lava poured down the valleys and created today's Spokane Falls
fractures occurred along the ocean floor as the granite and surrounding rock cooled
quantities of liquid granite were forced up and through ocean deposits
baking these rocks into shale, schist, quartzite and marble
silica containing metals flowed into these fissures becoming veins of ore
precious ores, gold, silver, copper, lead, and zinc were infused with liquid granite
volcanic activity continued in southern Oregon's Cascade Mountains
Mount Mazama, a 12,000-foot-high volcano, fell into its own crater
springs of water filled in the great hole to a depth of 2,000 feet
Crater Lake came into existence
Mount Multnomah, a 16,000-foot-high volcano, was destroyed by a violent eruption
choking the crater except for three small volcanic cones that formed Three Sisters peaks
this circular group of mountains show a far greater crater once existed

today these peaks are the third, fourth and fifth highest mountains in Oregon

Olympic Mountains appeared but only as a chain of islands off the Pacific coast

Pacific Ocean remained in place long enough to deposit mud and silt which captured sea animals

Puget Sound region rocks were formed by acquiring sediment

swamps were repeatedly covered with sand as the ocean periodically rose and fell

old lake bed was turned to rock, tilted and crumpled by earthquakes emptying out its waters

huge inland sea was drained or evaporated

mammals, as shown by fossil remains, abounded in the Puget Sound region:

•one animal, the oreodon, presented a curious assemblage of parts

that suggested a kinship to the deer, hog and camel

types varied -- some were as small as a fox, others were as large as an elk;

•little horses with three toes (mesohippus) existed in great numbers

they varied in size from the size of a large dog to that of a donkey;

•rhinoceros lived on the shores of the earliest lakes;

•several varieties of hogs and ferocious dogs of great size roamed the Puget Sound area;

•cats similar to the cougar armed with long, slender teeth were frequently found

as were the remains of miniature deer no larger than a rabbit

modern birds could be seen in the Puget Sound region

first hominids (human-like australopithecines) appeared on the planet in Africa

approximately four million years ago -- 11:59 on the twenty-four-hour clock

relatively complete skeleton named **"Lucy"** was found in Ethiopia by Donald Johnson -- 1978

she was named after the popular Beatles' 1967 song *Lucy in the Sky with Diamonds*

this female was dated to 3.2 million years ago

these small creatures were four to five feet tall and weighed between 65 and 120 pounds

australopithecines became extinct about two million years ago

*Early Quaternary Period* (or **"Pleistocene Epoch"**) began about 1.8 million year ago

and ended about 11 thousand years ago

major glaciers spread across North America and Europe

first humans (Homo sapiens) walked the Earth 200,000 years ago

along with gigantic wooly mammoths which were early relatives of mastodons

and, even later, elephants

wooly mammoths had long curved tusks and course hair falling below their knees

saber-toothed cats and 400 pound ground sloths roamed the region

giant sloths fifteen to eighteen feet long were covered with long hair called **"mylodon"**

they could rise on their hind legs to a height of ten feet tall long

sharp claws were both defensive weapons are a way to bring down prey

very thick hide protected them from all predators -- with the exception of humans

climate turned cold some scientists suggest massive ice sheets were formed
this most recent Ice Age in the Pacific Northwest was at least the fifth time
glaciers had covered the region
ice robbed much of the moisture from the oceans
sea level fell was as much as three hundred feet lower than today
low enough to form a long bridge between Asia and North America
even today North American and Asia remain close via the Bering Strait
scientists have discovered that as early as 25,000 years ago Alaska's central interior was ice free
elevation of western American was much higher during this **"Glacial Age"** than it is today
mountains had been elevated to stupendous heights by upheaval and volcanic action
erosion constantly wore down the surface of the Earth
wind erosion blew topsoil against mountains and uplands wearing them down like sandpaper
rivers washed away soil and cut amazingly deep canyons into solid rock
leaving **"V-shaped"** river valleys
ice glaciers wore away soil and rock and ground against the Pacific Northwest mountains
gouging **"U-shaped"** glacial valleys
there were two types of glaciers
"**Continental glaciers"** pushed down from the north and repeatedly covered large parts
of northern North America in ice sheets at times reaching over 10,000 feet thick
northern half of today's Washington was repeatedly covered as ice thawed and formed
forward edge of the continental glaciers scooped out Puget Sound and Lake Washington
as a tongue of glacial ice one-half mile thick covered Puget Sound
ice over Puget Sound reached its maximum advance south
to within a few miles south of today's Olympia, Washington -- 14,000 years ago
**"moraine,"** glacial junk and coal, was shoved ahead of the glaciers
as they moved very slowly south powered by their own enormous weight
when the Okanogan Valley was covered what is now Clark Fork River was dammed
**"Lake Missoula"** was formed in the Flathead Valley of Montana
Columbia River, which was much larger than it appears today, also was dammed
Columbia forced a new channel that was cut where Grand Coulee Dam stands today
this new channel became known as the **"Grand Coulee"**
it became the world's greatest example of canyon cut by a glacial river
417-foot-high **"Dry Falls,"** thought to be the greatest known waterfall that ever existed,
saw 300 feet of water roll over a cliff nearly three miles wide
pot holes bored by the falls today are known as Deep Lake and Perch Lake
water continued downriver to form Park Lake, Blue Lake, Alkali Lake
and Soap Lake

as the glaciers melted they left immense basalt boulders known as **"haystack"** rocks
**"Moses Coulee"** and the **"Channeled Scablands"** to the north of Grand Coulee
was created when Lake Missoula burst through the ice dam
**"Alpine glaciers"** of enormous size descended the Western Cascades slopes from high peaks
powered by it own massive weight these glaciers leveled the ground
as they plowed their way down mountain slopes and scoured the coastal plain
Alpine glacier canyons can be seen today in Washington State and still awe the beholder
the largest Alpine glacier was the one which advanced from Pend d'Oreille Lake
**"Pend d'Oreille Glacier"** closed the western end of the Spokane Valley
waters were impounded in the valley and formed a huge lake
other Alpine glaciers on the east side of the Cascades scooped out great lakes
southwest across present-day Spokane as far as Medical Lake and Spangle
beds of Chelan, Okanogan, Kootenai, Flathead, Priest, Coeur d'Alene,
and Arrow lakes were all scooped out by glaciers
yet another alpine glacier moved down the Yakima River Valley
throughout the Columbia Plateau of Eastern Washington
new channels were cut and old water courses were dammed
innumerable lakes were formed and transformed in shape and size
with the return of warmer climate approximately 14,000 years ago
land warmed and glacial ice sheets began to retreat
continental glaciers retreated to the north
alpine glaciers retreated into higher and higher elevations
scientific evidence exists that as the climate grew warmer
new lakes and saltwater sounds were formed
Lake Washington was free of ice -- 13,500 years ago
floods of water which had been trapped in the glacial ice were released
valleys were flooded by a sea level even higher than that of today
great shallow lakes fed by melt water from the mountains
filled the long trenches gouged out by the glaciers
melting caused floods in the interior on Eastern Washington
retreating Okanogan ice Lobe allowed Columbia River to resume its former course
abandoned channel, now left dry, became known as the Grand Coulee
Columbia River flowed through an area known today as the Channeled Scablands
Columbia Plateau was surrounded by rivers but had few surface streams
today it is composed of a gravel desert of hills and deep canyons
and has an extensive soil-covered area
ridges were separated by wide spaces with deep coulees

floods followed these channels and carried off soil leaving denuded hills
floods followed the line of least resistance deepening first the old channels
then excavating a maze of new channels
Scablands contained interlaced channels of varying depth -- a pattern within a pattern
two deep gashes, Moses Coulee and Grand Coulee
led away from the Okanogan ice Lobe which crossed the Columbia River
however, the melting ice cap alone could not supply the amount of water
necessary to cause the effect that resulted
perhaps the bursting of the ice barrier forming Lake Missoula on the northwest
released a sufficient amount of water

EFFECTS OF THE MOST RECENT ICE AGE CAN BE SEEN IN THE PACIFIC NORTHWEST

Today's Columbia River flows some 1,200 miles to the Pacific Ocean
it is one of the great rivers of the world draining about 259,000 square miles
Columbia River drainage includes 60,000 square miles of British Columbia in Canada
however, 85% of the river is located below the international boarder in the state of Washington
Washington, Oregon, all of Montana west of the Continental Divide, small areas of Nevada,
northern Utah and western Wyoming are drained by the Columbia and its tributaries
source of the Columbia River is Columbia Lake in eastern British Columbia, Canada
it runs between two stunning chains of mountains, the Selkirks in British Columbia
and the Cascades in Washington, Oregon and Northern California
Columbia River reaches its northern-most point at 52º north where it receives the Canoe River
Columbia then makes a grand turn and runs south into the Arrow Lakes
it soon joins the Kootenay River and its tributaries in British Columbia
entering today's Washington state the Columbia River acquires the Pend d'Oreille River
flowing from Lake Pend d'Oreille which is fed by Montana's Clark Fork River
Columbia River is now larger than North America's Rio Grande and Colorado rivers
and Europe's Seine and Elbe rivers
Spokane River from northern Idaho joins the Columbia
next the Okanogan River which drains southern British Columbia is added
making the Columbia larger than Asia's Tigris-Euphrates River
and Europe's Loire and Don rivers
Yakima River flowing from the Cascade Mountains enters the Columbia
Snake River beginning in Yellowstone Park flows through Wyoming, Nevada and Idaho
it delivers the waters of several major rivers including the Portneuf, Owyhee,
Malheur, Powder, Grande Ronde, Henrys Fork, Malad, Boise, Payette, Salmon,
Clearwater and Palouse rivers

here the Columbia becomes larger than Europe's Po, Dnieper and Rhone rivers and Africa's Nile River

Walla Walla River next empties into the Columbia

from Oregon the Columbia River receives the Umatilla River, Willow Creek, John Day, Deschutes, Hood, Sandy and Willamette rivers

Washington from the north side of the Columbia adds the Klickitat, White Salmon Lewis, Kalama, Toutle and Cowlitz rivers making it larger in volume than Africa's Zambezi, Europe's Rhine and Danube, Asia's Indus and North America's Fraser and Nelson

EROSION HAS CHANGED THE FACE OF THE EARTH SINCE THE LAST ICE AGE

Erosion by wind and water scarred the Earth's surface

underground water flowed in deep veins below the surface

this water was heated to the boiling point and dissolved minerals

boiling water escaped the Earth as geysers, or hot pools, or mud springs

springs also provided a surface outlet for underground water that ranges in temperature

soil in the Pacific Northwest, largely volcanic dust, remains extraordinarily fertile

CLIMATE HAS REMAINED HOSPITABLE SINCE THE LAST ICE AGE

Long warm periods between Ice Ages indicate climate change has taken place

land dried out over thousands of years -- giant Northwest forests began to be established

Japan Ocean Current bringing warm temperatures has an effect on the Pacific coast

Pacific Northwest is warmer in winter than other regions of the same latitude on the Atlantic coast or the Mississippi Valley

summer remains cooler than on the Atlantic coast

Cascade Mountains divide the region into a humid western section and a dry eastern section

**"Chinook Winds"** originally applied to summer winds which blew into the Willamette Valley

from the coast region north of the Columbia River where the Chinook Indians dwell

with usage the meaning was changed to the equatorial trade winds

that blow from the southwest in winter striking the coast from northern California to Alaska

currently Chinook Winds deliver rain west of the Cascades and penetrate to the interior

however, robbed of its moisture, the warm breath of the Chinook Winds

often causes the blanket of snow to disappear from the ground in a few hours

**"LATE QUATERNARY PERIOD"** OF THE CENOZOIC ERA

This final period is also known as the **"Holocene Epoch"** or **"Modern Age"**)

it has existed from about 11,000 years ago

Herds of horses and camels roamed Eastern Washington until they were driven off by cold

mass extinction of large mammals and many birds happened about 10,000 years ago
probably caused by the end of the last Ice Age
Comprehending the unimaginably vast geologic time that existed is impossible
understanding the events that took place is equally imponderable
even with the use of modern scientific equipment
and careful analysis of vast collections of fossils that have been unearthed
Native Americans had access to none of that equipment and information
so legends were proposed to explain the unknowable

## CHINOOK INDIANS HAVE THEIR OWN EXPLANATION OF GEOLOGIC TIME

Chinook Indians told of the great monster beaver, Wishpoosh, who inhabited Lake Kichelos[1]
at the summit of the (Cascade)[2] mountains at the source of the (Yakima) river
Wishpoosh was of enormous size and had a ravenous appetite
he was in the habit of seizing and devouring lesser creatures who came to fish at his lake
and even devoured vegetation to appease his hunger
Wishpoosh became so destructive that Speelyei, the coyote god of the (mid-Columbia) region,
attempted to kill the giant beaver
Speelyei went to the lake with his spear tied to his wrist and began to fish
as soon as Wishpoosh saw Speelyei invading his territory the giant beaver attacked
Speelyei threw his spear and struck the giant beaver
who immediately dove to the bottom of the lake dragging Coyote with him
Spellyei and Wishpoosh struggled so mightily they tore out the banks of the lake
floods waters swept down the canyon until the water was dammed up in greatest lake ever seen
located where the Columbia, Yakima and Snake rivers meet
But the struggle between Wishpoosh and Speelyei did not end
as the combatants tugged, ripped and bit at one another, the dam holding the great lake gave way
sending a huge wave down the Columbia River toward the ocean
Wishpoosh and Spellyei tumbled over and over again as they were swept down the river
Coyote god Spellyei grabbed bushes and rocks and trees to pull himself out of the massive wave
these efforts formed the Columbia Gorge but Spellyei still could not get out of the wave
Wishpoosh was furious that Spellyei had driven him from his beautiful lake
the giant beaver ate all of the salmon in the river ahead of him to increase his strength
then he swam out to sea with Spellyei in close pursuit
Wishpoosh threw his giant arms around a whale and swallowed it whole adding to his strength

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[1] William Denison Lyman. *The Columbia River: Its History, Its Myths, Its Scenery. Its Commerce.* P. 7-9.

[2] locations in parentheses (Cascade) indicate modern names for geographic locations

Spellyei was frightened by the giant beaver's might but coyote was the most cunning of animals
he turned himself into a tree branch and drifted among the fish until Wishpoosh swallowed him
Spellyei turned himself back into his natural form, took out his knife
and cut the insides of the giant beaver -- Wishpoosh gave a great cry and died
Spellyei called on his friend Muskrat who help drag the body of Wishpoosh to shore[3]
together coyote and muskrat threw the pieces of Wishpoosh on the land creating tribes of people
Nez Perce were made from the head of Wishpoosh to make them great in council
Cayuse were created from the massive arms of Wishpoosh
so they would be strong and powerful with war clubs and the bow
coyote made the Yakimas from the beaver's ribs and the Chinooks from the belly
beaver's legs were used to make the Klickitats so they would be skilled at running
remaining skin and blood were used to make the Snakes who thrived on war and blood
Once the tribes were formed Spellyei returned up the Columbia River to rest
but he was so weary that he did not notice the coastal people had been created without mouths
god Ecahni happened along and fixed the problem by cutting mouths for them
some he made too large and some he made crooked as a joke
this explained why the mouths of the coastal villagers were not quite perfect
Today's geologic explanation of the natural changes which took place over eons
is hardly less fantastic than the Native American version of geologic events

[3] S.E. Schlosser, *Coyote and Wishpoosh: from the Chinook Tribe, americanfolklore.net/folklore/2010/08/coyote_and_**wishpoosh**.html.*