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## FORWARD

Over the years I have felt the need for a concise source of information about individual countries. Without a complete set of encyclopedias and a number of other books, the information was not available. I especially felt the need when I began compiling information about DOOMSDAY and the future of the world and its peoples.

This book of the world is designed to give pertinent facts about the world without a great amount of detail. It is meant to introduce the world to the reader. Other books will complement and furnish the finer details. The bibliography describes books that belong in any library but are often too unwieldy for the purpose of quick reference.

The detailed geographic listings of lakes, rivers, mountains, and deserts are not generally available in one place. That is the goal of this book. ,

Weather equals the sum of (or product of) the effects of heat from the sun, the atmosphere, water, geography & topography, and latitude. Climate is the average of the weather during the year.

An integral part of any study of the world is its effect on all living things in any one part of that world. Encyclopedias such as World Book and books such as Smithsonian's "Earth", do a wonderful job of describing these phenomena but they are too bulky for use as handbooks. The section on *Climate* is intended to bring together the many parts of the equation that defines the environment on the many parts of the Earth.

The Smithsonian has published a book that should be in every home. It deals with every aspect of the world and is done in brilliant color. *Earth*. Its Glossary includes over 400 terms and its Index lists about 5000 lines of reference.

## WORLD

### GENERAL PHYSICAL CHARACTERISTICS

The earth is the third of four dense planets that orbit the sun. A fifth is the moon that orbits the earth. The earth makes a complete orbit of the sun in approximately 365 days and 6 hours, and rotates on its axis in 23.93 hours. Since the axis is at about 23.5 degrees from vertical in its rotation, it creates seasons.

#### EARTH: (e)

Age	Greater than 4.5 billion years
Orbit time	365.26 days
Rotation period	23.93 hours
Diameter	7,928 miles (12,726 km) at the equator 7,889.8 miles (pole to Pole)
Circumference	24,859.82 miles (40,000 Km)(at the equator)
Highest Elevation	29,028 feet (Mount Everest)
Lowest Elevation	-1,310 feet (surface of Dead Sea)
Deepest Point in Oceans	36,198 feet (Pacific Ocean, Mariana Trench)
Area, Total	196.8 million sq. miles
Water	139.5 million sq. miles
Land	57.3 million sq. miles
Mass	6.6 sextillion short tons
Av. Distance from Sun	93 million miles (149.6 million km.)
Axis tilt	23.5 % from vertical to the Sun
Average Temperature	57 F. (14 Celsius) (2005)

## GEOLOGICAL DEVELOPMENT

The history of the world covers an estimated 4.5 billion years. Geologists have named the various stages of the development and change in the earth and of the life that has flourished and its metamorphosis as climates changed. They use such time frames as *eons, eras, and periods* for time periods. *Earth, Smithsonian pp26-41*

### Abbreviations used"

Bil.	Billion
Bya	billion yeas ago
BP	before present
Mil.	Million
Mya	million years ago
Th.	Thousand

13,000 mya	The Big Bang
11,000 mya	Milky Way forms

4560 – 543 mya	Precambrian Eon
4560 – 3800 mya	Hadean Era
3800 – 2500 mya	Archean Era
2500 – 542 mya	Proterozoic Era
650 – 542 mya	Vending Period (Ediacaran Period)
543 – 0 mya	Phanerozoic Eon
543 – 252 mya	Paleozoic Era
542 – 488 mya	Cambrian Period
488 – 443 mya	Ordovician Period
443 – 416 mya	Silurian Period
416 – 339 mya	Devonian Period
339 – 290 mya	Carboniferous
339 – 323 mya	Mississippian Epoch
323 – 290 mya	Pennsylvanian Epoch
290 – 251 mya	Permian Period
251 – 65.5 mya	Mesozoic Era
250 – 199 mya	Triassic Period
199 – 145.5 mya	Jurassic Period
145 – 65.5 mya	Cretaceous Period
65.5 – 0	Cenozoic Era
65.5 – 23.03`	Paleogene
23.03 – 0 mya	Neogene
2.6 – 0 mya	Quaternary

## **HADEAN ERA** 4300 – 3800 mya

During this period, the rock that was to become our world became a collecting area. It is thought that the combined gravities of Jupiter and the Sun were necessary for the formation of the 4 inner rocky planets. The Earth was in collision with another heavenly body that separated part of its bulk forming the moon. The world was very hot from collisions and interior atomic energy. The earth was molten and surrounded by an atmosphere that contained both heavy and light elements. Much of the water and heavy elements were lost during this time. By the end of the Hadean Era, crust had formed and the atmosphere, high in carbon dioxide, had cooled to about 230 F. Some rock fragments have been found and studies of zircon crystals indicate that plate tectonics were formed as early as 4000 mya. Bombardment of the planets by comets and asteroids was over by 3800 mya. *Hadean – Wikipedia, the free encyclopedia*

## **ARCHEAN ERA** 3800-2500 mya

The atmosphere was high in carbon dioxide and with little oxygen. Temperatures were not greatly different from now because sun output was about 1/3 less than now. The oceans were more acidic than now because of high concentrations of carbon dioxide. There was considerable volcanic activity.

Cyan bacterial mats fossils are common, especially late during this period and are the source of free oxygen in the atmosphere. Life was probably all single-celled and non-nucleated. *Archean – Wikipedia, the free encyclopedia*

## **PROTEROZOIC ERA** 2500 – 542 mya.

The transition to an oxygen-rich atmosphere during the Mesoproterozoic period.

A number of glacial periods including one that covered the entire earth with snow and ice, finally ending with volcanic action that created a greenhouse effect.

“The Ediacaran Period produced is characterized by abundant soft-bodied multicellular organisms. “

Massive flows of volcanic basalt occurred, forming the Canadian Shield.

*Proterozoic – Wikipedia, the free encyclopedia.*

A super continent *Rodinia* existed from 1100 to 750 mya. Rodinia was entirely barren and dry like a desert. It also disrupted ocean currents and ultimately caused the snowball effect with the earth being a frozen waste. It was only after volcanic action spewed carbon dioxide into the air that the world warmed up. *Paleo Proterozoic –The Proterozoic Era (www)*

## **EDIACARAN PERIOD (VENDIAN PERIOD)** 650 – 543 mya.

The last period of the Proterozoic Era. It is a period of scarce life because of the end of the *Snowball Glacial* time when the world was covered with about 1 mile of ice and life forms were nearly wiped out. *Ediacaran – Wikipedia, the free encyclopedia*

*Pannonotia*, a super continent existed from about 600 + 540 mya.

Complex organisms were beginning to appear during the later part of this period.

## **PHAMEROZOIC EON** 543 - 0 mya

Life on land; the development of plant and animal life over the globe.

## **PALEOZOIC ERA 543 – 252 mya.**

Ancient Life – It is divided into six periods

### **CAMBRIAN PERIOD 542 – 488 mya**

A mass extinction occurred at 542 mya. This mass extinction is identical in dating to the dating of a layer of volcanic ash.

It was a period of exceptional preservation fossils, both soft tissue and hard shell. It is known as the Cambrian Explosion because of the large number of new species appeared. Many of these represent modern species though primitive. Life did not prosper on land. Land was barren with little more than a crust. Seas were relatively warm and Polar ice was absent.

Sea levels were high which led to many shallow seas, promoting growth.

### **ORDOVIAN PERIOD 488 – 443 mya**

Carbon Dioxide levels were up to 15 times present levels, creating a greenhouse effect. Plant life on land consisted of mosses and fungi, which began the process of soil building.

Oceans were extremely high causing a great number of shallow continental seas that promoted plant life.

Primitive fish appeared for the first time and the development of eyes. Primitive sharks appeared.

Much of the land mass was concentrated in South Polar Region and several glacial periods caused rise and fall of the seas.

A major ice age occurred at the end of the Ordovian period, causing a the second most severe extinction of species in world life history.

*Ordovian – Wikipedia, the free encyclopedia*

### **SILURIAN PERIOD 443 + 416 mya**

The climate warmed early in the Silurian period and the seas were high. There was extensive flora and fauna in the oceans. Fish attained great diversity and developed moveable jaws.

The first signs of terrestrial fauna appeared, forests of mosses along lakes and seashores. with some indication of possible land fauna..

*Silurian – Wikipedia, the free encyclopedia*

### **DEVONIAN PERIOD 416 – 339 mya**

It is called the age of fish with many new varieties and abundance. Sharks became plentiful and diverse. The seas were high with many shallow seas and the first abundant coral reefs.

Tectonic plates and the super continents *Gonwanda* and *Laurasia* were drifting toward each other. Plants developed seeds and roots during the Devonian period. Certain varieties of trees appeared in the late Devonian period. It is sometimes called the *Devonian Explosion*. Insects appeared at this time. Certain fish developed legs and became well established.

A late Devonian extinction especially affected marine life, especially in the shallow seas. Late developing species were less affected. The cause of the extinction is not known. *Devonian – Wikipedia, the free encyclopedia*

### **CARBONEFEROUS PERIOD** 339 – 290 mya

Landmasses are drifting and have formed Laurasia and Gondwana. The collision of these continents formed Pangaea.

Oceans were lower and the climate a little cooler. Oxygen levels rose to over 33%, compared to 21% today. This resulted in the growth of insects to sizes never again seen. Dragonflies had wingspans of up to 24 inches and other insects of equal size. This was the first appearance of hard-shelled eggs, necessary for land animals. Amphibians appeared at this time. Great forests of fern-like plants were the source of today's coal beds.

Great beds of coral grew during the early carboniferous  
Southern Gondwanaland was glacial throughout the period.

*Carboniferous – Wikipedia, the free encyclopedia*

### **PERMIAN PERIOD** 290 – 251 mya

The super continent *Pangaea* formed a “c” by 280 mya.

Sea levels remained low, severely habitat for marine life. Weather conditions would have been highly unstable because of a single large land mass. Pangaea was relatively dry with desert conditions in many areas. Much of Pangaea was a desert.

Dragonflies were the dominant flying insects and the relatives of the cockroach were the most successful ground fauna. Many new insect groups appeared. Reptiles appeared near the end of the period that would eventually become the dinosaurs.

The largest extinction on record occurred at the end of the Permian. It was gradual, occurring over a period of about eighty thousand years. It is theorized that the warming of the oceans released enormous quantities of hydrogen sulfide and/or methane, destroying the ozone layer and exposing living tissues to ultra violet rays.

*Permian – Wikipedia, the free encyclopedia*

### **MESOZOIC ERA** 251 – 65.5 mya

Permian-Triassic extinction is considered the greatest extinction in the earth's history with 90-95% of marine and 70% of terrestrial life becoming extinct.

*Mesozoic – Wikipedia, the free encyclopedia*

### **TRIASSIC PERIOD** 251 – 199 mya

Extinction events occurred at beginning and at end of Triassic Period.

Pterosaur, the flying vertebrate, made its appearance.

The super continent, Pangaea, was the only major landmass during the Triassic. The interior was desert because of its distance from water. Weather was erratic and often violent. Pangaea straddled the equator.

Seed-bearing plants and conifers began to dominate the flora.

Fauna included small examples of mammals and the development of amphibians and primitive dinosaurs. It took about 30 million years for life to rebound from the extermination event.



## **JURASSIC PERIOD** 199 – 145.5 mya

The super continent *Pangea* began to separate into parts about 175mya.

It is known as the “age of the dinosaur.” There were many giant herbivores such as *Diplodocus*, *Commeasures* and *Apatosaurus*, and they were preyed upon by the therapsids such as *Ceratosaurus*, *Megatosaurus* and *Torvosaurus*.

In the late Jurassic, the first bird evolved from small dinosaurs.. Pterosaurus ruled the skies.

Arid continental conditions of the Triassic eased during the Jurassic. The conifers were the most common of the trees and were the most diverse.. Seed ferns probably dominated the undergrowth. I

*Jurassic – Wikipedia, the free encyclopedia*

## **CRETACEOUS PERIOD** 145.5 – 65.5 MYA

Co2 levels were about 6 times pre-industrial levels., oxygen levels were about 150% of current levels and mean temperature was about 4 C (7 F) above current levels.

The sea levels were high and populated with many marine reptiles and fish and the land by dinosaurs now extinct.

Many new species including birds appeared. The Cretaceous Period ended with one of the largest mass extinction in earth’s history. Many species, including dinosaurs, large marine reptiles and Pterosaurus

The supercontinent Pangaea broke up into the present continents although they were far from their present locations. A shallow broad sea advanced across central North America. And then receded, leaving thick marine deposits. 1/3 of the earth’s landmasses were submerged during the height of the seas’ incursion.

A cooling period began in the late Jurassic and continued during the Cretaceous. Later in the Cretaceous the climate grew warmer and the tropics received more moisture. Tropical seas reached temperature of 37 C (107 F for a brief period. Deep ocean temperatures were also much higher. Many deposits of oil and gas were formed during the Cretaceous.

The Cretaceous ended abruptly with the collision of an asteroid in the Yucatan, causing a deep freeze. Species that depended on photosynthesis and many herbivores were especially decimated and many, including all dinosaurs became extinct. Omnivores, insectivores, and many carrion-eaters survived.

*Cretaceous – Wikipedia, the free encyclopedia*

## **CENOZOIC ERA** 65.5 – 0 MYA

The impact crater is located in the Yucatan Peninsula of Mexico. The asteroid is calculated to be about 10km (6.2 miles) in diameter. Energy would be about 2 million times the power of a large thermoneuclear bomb..

*KT-1 Boundary – Wikipedia, the free encyclopedia*

“The age of mammals.”

*Cenozoic – Wikipedia, the free encyclopedia*

## **PALEOGENE PERIOD** 65.5 – 23.03 mya

Inland seas retreated during this period as temperatures cooled. Birds and mammals expanded from a few varieties into a great number of species and sub-species the

continents continued moving toward their current positions. Most other branches of life showed little change. Deep ocean temperatures cool and became more hospitable. Ocean currents, that stagnated during the time of Pangaea, established flows that better distributed heat from the tropics. *Paleocene – Wikipedia, the free encyclopedia*

**NEOGENE PERIOD** 23.03 – 2.6 mya

Mammals and bird continued evolving. Other forms of life changed much less or remained relatively unchanged.

The most significant continental change was volcanic activity that connected North and South America. It completely changed the flow of ocean currents. Climates cooled in many areas and Glaciations occurred with an accompanying fall in ocean levels.

*Neogene – Wikipedia, the free encyclopedia.*

**QUATENE PERIOD (QUATENARY PERIOD)** 2.6 – 0 mya

The Quaternary boundary marks the beginning of the current glacial period, beginning about 2.588 million years ago. Repeated glacial epochs saw glaciers advance below the 40<sup>th</sup> parallel and retreat. A major factor is probably variations in total solar energy.

The last glacial period ended 11,700 years ago and a number of land animals became extinct shortly thereafter.

*Quaternary – Wikipedia, the free encyclopedia*

The Rhyolite Caldera super volcano *Toba*, exploded about 65,000 years ago, triggering a worldwide decades-long cold period, creating a mass extinction. Nearly the entire *Homo sapiens* genus was lost. It is estimated that fewer than 2,000 survived.

*Toba VolcanoCh 5 – Human Evolution*

[Http://www.andaman.org/bookBOOK/originals/Weber//bottleneck/ch.5.htm](http://www.andaman.org/bookBOOK/originals/Weber//bottleneck/ch.5.htm)

## EARTH'S MAKEUP: (a)

Inner core: solid, density 12 g/cm cu.; depth below surface, 3,960 miles (6,370 Km); temperature, 7,200 to 8,000 F

Outer Core: liquid, density 10 g/cm cu.; depth, 3,200 miles (5,150 km.); Temperature, 6,500 to 7,200 F.

Lower Mantle: solid, density 5.3 g/cm cu.; depth, 1,860 miles (2,999 km.); Temperature, 1,800-6,500 F.

Upper Mantle: solid, density, 3.5 g/cm cu.; depth 3-48 miles (5-70 km.) Temperature, 1,800 F.

Continental Crust: solid, density 2.5 g/cm cu.; 0-45 miles.

Temperature: under 1,800F.

Chemical makeup of crust:, by weight (e)

Oxygen	46.6%
Silicon	27.7%
Aluminum	8.1%
Iron	5.0%
Calcium	3.6%
Sodium	2.8%
Potassium	2.6%
Magnesium	2.0%
All other elements	1.6%

## HEAT TRANSFER

“The temperature of the Earth’s inner core is thought to be about 8,500 F.(4,700 C). Heat is convected through the overlying core of liquid metal to the base of the mantle, where temperatures are about 6,300 F (3,500 C). At such temperatures silicate rock would normally be molten but the intense pressure deep inside the Earth keep the rocks of the mantle solid. However, rising heat from the core causes the mantle to slowly circulate, its solid rocks sliding by just a few inches a year, and convecting heat away from the core as they do so. Hot mantle rocks slowly rise toward the surface, cooling until they become denser and sink back down to form a convection cell. The top of the cell coincides with the base of the cool and brittle outer lithosphere. This is broken into a series of tectonic plates, the motion of which is thought to be driven in part by the convection below them.” *Smithsonian “Earth”*

## THE CRUST

“The crust averages about 18 miles thick under the continents and about 6 miles thick under the oceans. The crust lies on top of the more rigid mantle and the boundary between the two is marked by the Mohorovicic seismic discontinuity.” (a)

Variation in thickness and density of the crust account for its topography. The continental crust accounts for about 1/3 of the Earth's surface. The continental crust varies from 16 to 45 miles in thickness. Its composition will vary depending on the history of the area.

Volcanoes are the sources of the materials on the land. Lava has all the elements that will eventually make up the land around us. The gases are made up of many compounds, including water vapor, carbon dioxide, nitrous oxide, and sulfur dioxide.

It was perhaps 4 billion years ago that water began to collect in low-lying areas. The temperatures were high for this was a world with many greenhouse gases including methane, and radiation from the interior of the earth. A miracle occurred as the first green scum that actually absorbed carbon dioxide and compounds of nitrogen and gave off oxygen as a byproduct of its growth. As oxygen approached its present level, it became rich enough to form ozone, an effective shield against ultra violet rays. At this point, it was possible for life to exist on land.

From plants in the water came plants on the land. Great beds of these plants were eventually covered by seas and seabeds. Today these plants have become the fossil fuel we are dependent on.

Volcanoes, worldwide, continue bringing their bounty to the sea floor and to the land. The lava, the ash and the gases are the building blocks that add to the bulk of the continents.

## TECTONIC PLATES ©

The crust of the world is made up of many fragments that we call *tectonic plates*. The largest of these is the Pacific Plate (42 million sq. miles). It is followed in size by the African Plate, the Eurasian Plate, the Australian Plate, the North American Plate, the Antarctic Plate and the South American Plate. About a dozen smaller plates account for most of the rest of the crust. Each tectonic plate moves independently of the others. Wherever they collide, one will tend to slide under the other, creating a subduction zone where there will be uplift mountains and/or volcanoes. Other boundaries seem comparatively quiet.

The boundaries of plates are divergent, convergent or sliding.

Divergent boundaries occur where plates are moving apart. The voids are filled with mantle material (magma) that becomes liquid as the plates move apart and flows to fill the void. It then solidifies as it is exposed to the cooler ocean. The widest divergent area is Iceland.

Convergent areas are created as plates move against each other. Usually the thinner ocean plate will subduct (slide under the other) because of its lighter weight. The Andes Mountains are an example of subduction. They are made up both of upheaval mountains and volcanoes. In other cases the plates collide, forming mountain chains such as the Himalayan chain.

The sliding action of plates occur in such areas as Southern California

PANGAEA was a super-continent until about 200 million years ago. At that time, the various continental segments began to drift in different directions. Today there are at least 55 plates, most of which are moving above the mantle, each in its own direction.

There are 16 major tectonic plates and 40 minor tectonic plates listed on the World Wide Web. Twelve ancient plates are considered part of current plates. (*List of Tectonic plates – Wikipedia*)

## MAJOR TECTONIC PLATES:

**AFRICAN PLATE:** (c: pp488-9) (32 million sq. miles) (82 million sq km)

The African Plate includes all of Africa, part of the Atlantic, Southern, and Indian Oceans. It also includes part of the Mediterranean Sea. It is moving to the East and the North. The drift is away from the S. American Plate, causing the Atlantic Ocean to increase in size. To the East, the African Plate is in collision with the Australian Plate, causing many earthquakes and volcanic action in the East Indies. In East Africa, the Great Rift Valley is an area in which a small part of the African Plate is breaking off and will become a separate plate that will include Madagascar. This new plate will be in a collision course with the Arabian Plate. A new sea will encompass the area of the Rift Valley. This process will take many million years.

With the exception of the Atlas mountains there are no Great ranges. Much of the continent is warped into plateaus and basins. (*African Plate – Wikipedia*)

**ANTARCTIC PLATE:** (24 million sq. miles) (62 million sq km) (c: pp 494-5)

The Antarctic plate includes all of Antarctica and part of the Southern Pacific and Atlantic Oceans. The movement of the Antarctic Plate is not shown. Antarctica is situated in the middle of the Antarctica Plate. The plate extends a thousand or more miles beyond the continent except near S. America. Wikipedia shows the Antarctic Plate at 10 million sq miles (16 million sq. km.) (*Antarctic Plate – Wikipedia*)

**ARABIAN PLATE:**

The Arabian Plate is a small plate that includes Jordan, Iraq and the Arabian Peninsula and extends to Turkey. It is moving toward the North, colliding with the Eurasian Plate. (*Arabian Plate - Wikipedia*)

**AUSTRALIAN-INDIAN PLATE:** (18 million sq. miles) (47 million sq km)  
(c: pp 490-1)

It is moving about 35 degrees east of north at a rate of 2.66 inches (67 mm.) a year, colliding with the Pacific, Bismarck, and Philippine Plates. It is diverging with the Antarctic Plate. The Australian Plate and the Indian Plate are moving in a similar direction so there is very little interactions between them.

It includes all of Australia, Indonesia and extends into the Indian Ocean on the west and to New Zealand on the East., Some geographers include the Indian subcontinent in this plate although they are separate plates moving synchronously. It also includes much of the Indian Ocean and New Guinea. Its drift is toward the Northeast and the North

Although the Australian plate is deemed responsible for the growth of the Himalayas, it is shown as not including India or the western part of the East Indies and the Malayan Peninsula., which are included in the Eurasian Plate. (*Indo-Australian Plate.*)

**BISMARCK PLATE:**

The Bismarck Plate is a small plate between the Pacific Plate and the Australian Plate. The Pacific Plate is subducting under the Bismarck Plate.

CARIBBEAN PLATE: 1.2 million sq. miles (3.2 million sq. km.)

It is a small plate that includes all of Central America and the Caribbean Sea. It touches the coast of South America and extends north to Cuba. The Cocos Plate is subducting under the Caribbean Plate creating a volcanic zone. It is moving eastward.

*(Caribbean Plate – Wikipedia)*

CAROLINE PLATE:

It is a small plate between the Australian and Pacific plates. The Pacific Plate is subducting beneath the Caroline Plate

COCOS PLATE:

It is a very small plate beneath the Pacific Ocean. It touches Central America on the North, the Nazca Plate on the South and SE, and the Pacific Plate on the West. It is subducting the Caribbean plate in Central America, creating a volcanic and earthquake zone. The devastating 1985 Mexican City earthquake was caused by disturbances in the Cocos Tectonic Plate. *Cocos Plate – Wikipedia)*

GUANDU PLATE:

It is a very small plate along the Pacific boundary with the North American Plate in the area of the Pacific Northwest..

EURASIAN PLATE: (35 million sq. miles) (91 million sq km) (c: pp 486-7)

The Smithsonian ranks Eurasia as the largest tectonic plate. The Eurasian Plate includes all of Europe and Asia North of India, Arabia and the African Plate. It includes much of the Mediterranean Sea and extends West across the Atlantic as far as Iceland. Its drift is toward the Southeast. The Eurasian and N. American plates are pulling apart in the Atlantic Ocean, causing it to expand.. On the Pacific Ocean, the Eurasian and N. American plates are in collision, creating mountains and volcanoes in E. Siberia. On the South the collision between the Australian-Indian Plate and the Eurasian Plate have created the still-growing Himalayas . Many of the world's oldest rocks are exposed in eastern Siberia. *(Indian Plate – Wikipedia)*

INDIAN PLATE:

It is moving north-northeast as part of the Indo-Australian Plate. It is in direct collision with the Eurasian plate; the collision forming the Himalayas and adjacent mountain ranges. *(Indian Plate – Wikipedia)*

JUAN DE FUCA:

It is a plate between the North American Plate on the East and the Pacific Plate on the West. It is from Northern California to British Columbia. The subduction of the Juan de Fuca under the North American Plate is the source of the “Ring of Fire” volcanoes in Northern California, Oregon, Washington, and southern British Columbia. The last major earthquake (9 on the Richter Scale) was recorded by the Japanese as January 20, 1700. *(Juan de Fuca Plate – Wikipedia)*

#### NAZCA PLATE:

The Nazca Plate is located to the West of the South American Plate with the Pacific Plate to the West and the Antarctic Plate to the South. It is about 3-5 million square miles (8-13 sq km) of the Pacific Ocean. Its drift is to the East. It is the fastest moving plate and, as it subducts the S. American plate it generates earthquakes and volcanoes along the length of the Andes. (*Nazca Plate – Wikipedia*)

NORTH AMERICAN PLATE: (24 million sq. miles) (62 million sq km) (c; pp 482-3)

(sixth largest plate) It includes all of the North American Continent and includes Cuba, Greenland and half of the Atlantic Ocean to the East, the Aleutians and part of Eastern Siberia. Its drift is towards the West. Iceland is situated on the rift between the N. American and Eurasian plates.

It was joined to the Eurasian, African, and South American plates until the plates began to move apart and the Atlantic Ocean began to form. The process is continuing and the mid-Atlantic range marks the area of separation. “The relatively young mountains of western N. America mark the collision and subduction of the Pacific Plate.” (d)

The older Appalachian mountains of N. America reflect a pre- Pangean plate collision. (*North American Plate - Wikipedia*)

PACIFIC PLATE: (42 million sq. miles) (109 sq km) (c: 492-3)

The Pacific Plate is the largest plate with 42 million square miles. “Earth” rates Eurasia as the largest plate. It includes all the Pacific Ocean farther west than the North American Plate, South of the Aleutian Islands and West to the Eurasian, Philippine and Australian plates. In the West, there is a combination of lateral motion as well as separation. In the East the Pacific Plate is in a process of subduction with the Australian, Eurasian, Caroline, Philippine, and Bismarck plates, causing major subduction zones and the deepest trench the *Marianas Trench*. The Pacific Plate is made up of several smaller plates but as the Pacific Plate moved the others were subducted under the Americas.

(*Pacific Plate - Wikipedia*)

#### PHILIPPINE PLATE:

The Philippine Plate is a long narrow plate between the Pacific Plate and the Eurasian Plate. To the east is the subducting Pacific Plate at the Mariana Trench, on the west by the Eurasian Plate, on the south by the Indo-Australian Trench, on the north by the North American Trench and on the northeast by the Okhotsk Plate.

Land wise it is east of the Philippines. Taiwan and the Ryukus are to the northwest, the Americas are to the east and Palau and Indonesia are to the south. (*Philippine Plate – Wikipedia*)

#### SCOTA PLATE:

The Scotia Plate is a small plate between the South America plate on the north and the Antarctic plate on the south and west. On the east it has a spreading boundary with the tiny Sandwich plate, which is subducting the eastern South America plate. Its length is East-West. (*Scotia plate – Wikipedia*)



SOUTH AMERICAN PLATE: (23 million sq. miles) (60 million sq km) (c: pp 484-5)  
 ( seventh and smallest of the major tectonic plates) The South American Plate includes all of South America and half of the Atlantic Ocean to the southern part of the Atlantic Ridge. Its drift is toward the West and an extremely slow drift north.

On the east is a diverging boundary with the African plate, , in the south is a boundary with the Antarctic and Scotia plates, on the west is a boundary with a converging boundary with the subducting Nazca plate and the north is a boundary with the Caribbean plate.

As it expands, it separates from the African plate and is in collision with the Nazca Plate to the West . The subduction of the Nazca Plate has created the Andes Mountains. (*South American Plate – Wikipedia*)

### PLATE BOUNDARIES – FAULT LINES

Faults occur when plates move toward each other (converge); move away from each other (diverge); move past each other (slip), a plate moves upward (upthrust) or a plate plunges under another (subduct). There are also some combinations of motion. A joint is the movement of two plates in the same direction without stress.

“Faults are cracks in rocks, across which there have been displacement. They range from tiny fissures to sets of interconnecting faults that are many miles long. Some active faults move in a slow continuous manner called *creep*. Most often, they move in a series of spasms which can release energy in the form of earthquakes.” (f)

Below is a listing of tectonic plates and their movement.

#### PLATE DRIFT

PLATE	Drift*
African	East & North
Antarctic	drift not indicated
Arabian	north
Australian	north-northeast
Bismarck	-----
Caribbean	-----
Caroline	north
Cocos	-----
Eurasian	southeast
Guanda	-----
Nazca	east
North American	west
Pacific	northwest
Philippine	-----
Scotia	-----
South American	west

\*drift varies but averages about 4 inches a year

## MAJOR FAULTS

- Basin and Range: *Dip-slip* (complex pattern) crossing California, Utah, Oregon, Arizona, Texas and extending into Mexico. It covers an area of 940,000 sq. miles. More than 100 mountain ranges run roughly North and South
- East African Rift: *Normal dip-slip*, (Active) east Red Sea to Mozambique. The rift pattern extends through the Dead Sea in Israel-Jordan. The East Africa plate is moving away from the African plate and will eventually form an island off the coast of Africa
- Great Alpine Fault: *Strike-slip* (right lateral) length, 310 miles (500 km.) New Zealand, South Island from Fiordland to Blenheim. In the ocean to the east of the North Island, the Pacific Plate is subducted under the Australian Plate, creating New Zealand's volcanic fields.
- Midland Valley: *Slide-slip* (right lateral) length, 56 miles (100 km). (Inactive) Running east & west in Scottish Highlands.
- Moine Thrust: *Reverse thrusts, t dip-slip* (Inactive) running from the Isle of Skye to Moine, Scotland
- Nojima Fault: *Strike-slip* (right-lateral) Osaka bay, Japan, between Korea & Japan  
*Earthquake:* Kobe, Japan, 6,300 killed; 300,000 left homeless, worst since 1923.
- North Anatolian Fault: *Strike-slip* (right lateral) (Active) extending 6600 miles across N. Turkey and the Sea of Manmara.  
*Major earthquake:* 1999, quake killed 1,100 and caused considerable damage.
- North Sea Basin; *Normal dip-slip*. (Inactive) circular fault beneath the North Sea.
- Rhine Rift: *Reverse thrust, dip-slip*, (active) from the Swiss Alps to the North Sea. Rift formed as two halves of European plate converged between 400 & 500 million year ago..  
*Earthquake:* 1356 was the most violent in Europe in recorded history.
- Southeast Korea: *Strike-slip* left lateral) located on the Southern edge of the Korean Peninsula. The length is 124 miles. The *Yangsan* is one of more than 100 faults in Korea. At least one earthquake occurs each year.
- San Andreas Fault: *Strike-slip* (right lateral) extending from Cape Mendocino in northern California to the Gulf of California. Rocks move across each other in opposite directions.. Since it forms a boundary, it is also a transform fault  
*Major earthquake:* April 12, 1906 with major destruction in San Francisco, Ca.

## MAJOR EARTHQUAKES:

Aleutian Islands; Jan. 4, 1965; mag. 8.7 Richter.  
Andiaatot Islands, Mar. 9, 1957, mag. 9.1 Richter  
Banda Sea: Feb. 1, 1958; mag. 8.5 Richter  
Ecuador (coastal): Jan. 31, 1906; mag. 8.8 Richter.  
Indo China: Aug. 15, 1952: mag. 8.6 Richter  
Japan, Kobe, Jan. 17, 1995; mag. 6.9 Richter. *Nojima Fault*. 6,300 people died,  
300,000 were left homeless and 100,000 buildings were destroyed..  
Indonesia: Dec. 26, 2005, Tsunami from ocean uplift of 70 feet, causing death  
& destruction all the way to Africa, thousands of miles away. Death toll was over  
200,000.  
Kamchatka: Feb. 30, 1925, Mag. 8.5 Richter  
Kamchatka,: Nov. 12, 1952. mag. 9.0 Richter  
Rhine Rift: 1356. damage to buildings 200 miles from the Rhine  
Russia, Siberia, Kurile Is., Oct. 19, 1960, mag. 8.5 Richter  
U.S.A., San Francisco, CA. *San Andreas Fault*, almost total destruction of city  
U.S.A., Alaska; Prince William Sound, Mar. 26, 1964, mag. 9.1 Richter;  
May 22, 1960: magnitude, 9.5 Richter, Chile; tsunami caused deaths in Hilo,  
Hawaii.

Note: Details of earthquakes are dealt with under “Cataclysms” *Earthquakes*

## CONTINENTS

AFRICA (53 political subdivisions)  
ASIA (35 political subdivisions)  
AUSTRALIA  
EUROPE (43 political subdivisions)  
LATIN AMERICA ((34 political subdivisions)  
MIDDLE EAST (17 political subdivisions)  
NORTH AMERICA (U.S. Mexico & Canada)  
PACIFIC ISLAND NATIONS (13 political subdivisions)  
SOUTH AMERIA (See Latin America)

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- (a) *Earth*, Smithsonian, “The Crust” p 58.
- (b) *Worldbook*, 1993. Volume 15, “Plates, Tectonic” pp 561-565
- © *Earth*, 2003. “The Earths Plates” pp 482-495
- (d) *Ibid.* p 482
- (e) *Worldbook*, 1993: Volume 6 “The Earth” pp 17-32.
- (f) *Earth*, Smithsonian. “Mountains, Volcanoes & Earthquakes” p 142 .

## SUN AND CLIMATE

Climate is the average of the weather over a period of years. An analysis of climate will include certain factors we call constants; i.e. Solar Radiation, Latitude, Terrain and location with reference to mountains, oceans and any other significant area influences. Variables include changes in ocean currents and weather patterns.,

Certain variables are called “Acts of God” because they can not be predicted and have no regular pattern of occurrence. They are earthquakes, volcanoes and catastrophic floods. The San Francisco Earthquake of 1906 and the eruption of Tambora in 1815 are examples of this.

Each of these factors is discussed below and separate articles are included.

SUN: Its general output can be counted on for long periods of time. Over long periods of time the sun’s output may decrease or increase. At that time, the climate will undergo changes such as ice ages.

LATITUDE: The Latitude directly affects the amount of Solar Energy receives per square unit over the period of a year. Simply put, the angle of sunlight will affect the amount of energy received. The figures below do not take into account the effect of atmosphere, which will vary with altitude, the radiation passes through before it reaches the ground. The standard of intensity gives sunlight from directly above as 1.00.

Latitude	Seasonal Range	Average Intensity	Typical Cities
Equator	.92 to 1.00	.96	
Tropic of Capricorn	.68 to 1.00	.88	
Tropic of Cancer	.68 to 1.00	.86	
Latitude 30 degrees	.59 to .99	.83	
Latitude 45 degrees	.37 to .93	.68	
Latitude 60 degrees	.11 to .80	.48	
Artic Circle	.00 to .73	.38	
Antarctic Circle	.00 to .73	.38	
Latitude 75 degrees	.00 to .62	.28	
Latitude 90 degrees	.00 to .40	.20	

The variable is the reflective value and absorption of heat. Snow will reflect up to 90% of solar energy. Dark soil will absorb and give off conduction heat to the air. Water stores much of the energy and gradually heats the air. As snow cover disappears, more of the solar radiation will be stored for release to the air.

## SUN

General: It is a smaller star on the fringe of a galaxy call the *Milky Way*.

*Diameter:* is about 865 thousand miles (1,393 thousand km) (108 times that of earth)

*Volume:* about 1.9 million times that of earth.

*Revolution:* about once a month

*Orbital Speed:* about 150 miles (240 km) a second

*Orbit in Milky Way:* about 200 million years

*Age:* about 4.6 billion years

*Temperature at surface:* about 10,000 degrees F. (6,000 C.)

*Composition of the Sun:* The Sun is classified as a huge ball of glowing gases. It is about 75% hydrogen and 25% helium. About 70 other elements make up about 1% of its mass.

*Corona:* The atmospheric surface of the Sun is about 300 miles thick. This layer is about 10,000 degrees F. and is the source of the release of radiation from the sun. Sun Spots are thin areas of the atmosphere and give off far less radiation.

*Life Span:* It is believed that the sun will maintain its present output of radiation for about another 4 billion years.

*Radiation:* In addition to visible light and heat the sun also radiates ultra-violet, radio, x-ray, and magnetic waves.

*Magnetic Storm:* An increase in magnetic radiation by the Sun occurs especially from Solar Flares. These storms can disrupt communication and other activities related to magnetic factors. Satellites are vulnerable. ©

*Solar Flare:* A *solar flare* is a violent release of energy into space, sometimes as much as 500,000 miles. It releases a violent burst of energy in the form of light, heat, and magnetic waves. A Solar Flare lasts up to an hour. See also *Magnetic Storm*.

*Solar Wind:* Activity from the interior of the Sun sends ions of material (mostly positive) from the polar areas and from solar storms, These particles are prevented from reaching the surface of the Earth by the *magnetosphere* (the extent of the Earth's magnetic field about 40,000 miles from the Earth).(b)

*Sun Spots:* Thin spots in the Corona. Their activity varies in 11 and 22 year cycles. A period of high sunspot activity reduces the energy received by the Earth.

The sun has a comparatively constant output. The intensity will decrease during solar storms (sunspot activity). There are long-term cycles during which the intensity of radiation received by the earth will be less than at present. These periods resulted in Ice ages during the past 100,000 years. The last ice age, (called the *Little Ice Age*), occurred between 1200 A.D. and 1810 A.D.

The Earth travels in an ellipse around the sun. The nearest point is about 91.4 million miles and the farthest is about 94.5 million miles.

The climate at any degree of latitude on the Earth affects directly the amount of Solar Energy that area receives. All areas between the Tropic of Cancer and the Tropic of Capricorn receive rays from directly above at some time during the Earth year. This is further discussed in the section on Climate.

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- (a) *Worldbook, 1993*: Volume 18; "Sun" pp 974 ff.
- (b) *Worldbook, 1993*: Volume 18, "Solar Wind" pp581 f
- (c) *Worldbook, 1993*: Volume 13 "Magnetic Storms" 0 57.

## AIR

Air seems without substance or weight. Anyone who has sailed in a gale or faced a strong wind is conscious of its presence. Its weight is usually expressed in inches of mercury. The weight of air is expressed in density. The air above a person on a mountain is far less dense than at sea level. The density of air will also vary according to weather patterns. The weather service will express high or low-pressure areas in inches of mercury, or in millibars, to indicate high or low pressure areas and the likely direction of winds or storms. Air flows from a high-pressure area toward a low-pressure area.

The density and composition of air are as follows: (a)

Elevation, 50,000 ft	1.8 lb. Per sq inch
40,000 ft.	2.8 lb. Per sq. inch
30,000 ft.	4.5 lb. Per sq. inch.
20,000 ft	6.8 lib. Per sq. inch
10,000 ft	10.2 lb. per sq. inch
Sea level	14.7 lb. per sq. inch

Air pressure is measured in terms of inches of mercury or metric millibars. Air pressure at sea level averages 29.92 inches of mercury or 1.013 millibars.

At sea level the total weight is about 1.06 ton per sq. foot or about 29.51 million ton per square mile.

Air, at sea level, weights a bout 2 ounces per cubic foot and requires .018 b.t.u. Of heat to raise its temperature 1 degree. (see section on weather) The amount of heat stored in the air is significant. Water vapor in the air stores far more heat per unit than air itself. Thus you will see that air over the desert will cool much more rapidly at night than air in tropical areas will.

The composition of dry air is approximately the following in 1999:

Nitrogen	78.%
Oxygen	21%
Argon	0.94%
Carbon-dioxide	0.03%

Other elements such as hydro-fluorocarbons, methane, dust and other materials make up the rest. Among the minor gasses in the air are nitrous- oxide, carbon-monoxide, helium, krypton, xenon, and ozone.

*Aerosols* are fine particles of matter so fine that they float in the air and only slowly fall to the ground. An example of that is pollen. Many industrial plants and power plants are the sources of such particles. Volcanic eruption commonly expel ash into



the air. Depending upon the violence of the eruption, these particles may take months or years to reach the ground or other surfaces. *See Climate*

*Energy in the Atmosphere: See Climate*

*Humidity* is the amount of water vapor that the air contains. A humidity of 100% is about 4% of total air volume.

*Ozone* forms in the Stratosphere and is a key to absorption of harmful ultra-violet rays.

*Water Vapor* is present in the air everywhere. As air is warmed, it will hold more water vapor. The amount of water in the air is expressed as degrees of humidity or percent of total capacity of the air at that temperature. Air, in cooler climates will have far less capacity for water vapor than tropical areas because of lower temperature.

## ATMOSPHERE

The atmosphere is classified in 4 layers, each clearly separate from the others by air temperature boundaries that limit air exchange. (b)

The atmosphere is not measurably warmed by the direct rays of the sun. Radiation from the sun passes through transparent materials and heats the earth and oceans below. Some of the radiation is bounced back to space especially by light colored surfaces. Over 90% of radiation that hits snow will be radiated back to space. Colors have different reflective values. White reflects about 93%; yellow reflects about 50% and dull black reflects about 7%.

*Troposphere:* sea level to 5 miles at the poles and sea level to 10 miles at the Equator. The troposphere is that part of the atmosphere in which the air circulates both vertically and directionally. *The section on climate discusses the functions of the troposphere more fully.*

*Tropopause:* The dividing line separating the troposphere and the stratosphere.

*Stratosphere:* From the tropopause to *about* 28 to 30 miles elevation.

*Stratopause:* is the boundary between the stratosphere and the mesosphere.

*Mesosphere:* from about 30 miles to 50 miles above the earth.

*Mesopause:* is the boundary between the mesosphere and the thermosphere.

*Thermosphere:* extends from 50 to about 650 miles above the earth.

**TROPOSPHERE:** The air, heated by contact with the surface of the earth, moves upward, cooling and expanding as it does. By the time it reaches the tropopause, it ceases to rise because of loss of head and loss of density. *See Climate*

The temperature will drop to about -85 F (-55 C)

*Weather & Climate:* is the result of the ability of the atmosphere to absorb and give off heat and water and to flow both horizontally and vertically in the troposphere.

STRATOSPHERE: is from the tropopause to 28 miles altitude. Unlike the thermosphere, air in the stratosphere tends to stratify, with little vertical motion. Temperatures are so low that moisture forms tiny ice crystals that reflect sunlight.

Temperatures range from -57 at the bottom to about +28 F at the stratopause.

*Ozone* forms in a thin layer in the stratosphere and is a key to the filtering out of harmful ultraviolet rays. Ozone makes up about 1 part in 100,000 parts of oxygen in the ozone layer. Ozone filters out about 90% to 95% of the ultraviolet light from the sun and converts it into heat.

MESOSPHERE. It is the space between 28 and 50 miles altitude.

From the stratopause at 28 miles altitude to 35 miles altitude.

Temperatures are -112 F. (-80 C) and may be as low as -171 F. (-113 C.) near the mesopause.

Extremely high winds blow in this area from west to east in the winter and from the east to the west in the summer.

THERMOSPHERE: ranges from 50 to 650 miles above the earth. The thermosphere contains

Less than .01% of the air in the atmosphere. The outer regions of the thermosphere are made mostly of hydrogen and helium atoms. Temperatures from 100F at 120 miles to as high as 3000 F at 600 miles because the upper air has no shielding.

*Ionosphere* is the range from 50 to 300 miles from the earth.

*Exosphere* is the range from 300 to 650 miles above the earth.

Temperatures at the outer boundary rise to 1800 F (1,000 C) because of absorption of ultraviolet rays. This layer gradually merges with the vacuum of Space.

ORIGIN OF THE ATMOSPHERE: The formation of the earth, about 4 ½ billion years ago probably was without an atmosphere. (Some geographers believe that an atmosphere of nitrogen and methane existed almost from the beginning) Gases escaping from the developing earth began to collect. Numerous volcanoes on the young planet released sulfur, carbon dioxide, nitrogen, water, ammonia, methane, and other gases. There was very little oxygen at the beginning. Algae began to form in the seas and gave off oxygen. By 3 ½ billion years ago, the oxygen was beginning to accumulate. A proliferation of plant species built up oxygen levels by 400 million B.C. to about what they are today

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(a) *Worldbook, 1993, Volume 1, pp 165-174.*

(b) *Earth, Smithsonian, 2003. "Structures of the Atmosphere", pp 440 ff*

© *Worldbook, 1993, Volume 1, pp 173-4/*

## WATER

Water is composed of two atoms of hydrogen to one of oxygen. In its liquid state is not compressible. It expands in volume as it is heated and forms a vapor at 212 degrees F. (100 C) at sea level. The vaporization (boiling point changes with atmospheric pressure. Water at high altitudes boils at a lower temperature. Similarly the water remains liquid at far above 212 F in a confined area that allows pressure to build up.

It is at its densest at 39 F (4 C) and in its frozen state its weight per mass is 92% that of water or a specific gravity of .92. Seawater, because of its salt and other materials, has a specific gravity of 1.03. (a)

Water has a very high capacity for storing heat. It requires ½ BTU to heat a pound of ice 1 degree; 50 BTU to melt ice at 32 F; 1 BTU for each degree of rise in temperature of the liquid to 212 F or the point of vaporization; It takes about 535 BTU to change the water to vapor and ½ BTU to increase the temperature of the vapor for each additional degree. Water, left in an open vessel will gradually vaporize. This process is absorbing as many BTUs of energy per pound as at 212 degrees. At higher altitudes, water turns to vapor at lower temperatures.(b)

Water is known as a universal solvent since there are a great number of elements, compounds, and chemicals that will dissolve in water. This factor also creates the problem of pollution as many chemicals and other waste products are dumped into our lakes, waterways and oceans.

Because of widespread melting of Polar Ice, several scenarios have been presented. One suggests that the fresh water from the ice melt will tend to stay on top and disrupt the course of the Ocean currents, especially the Gulf Stream. See articles on oceans and climate. Ocean levels rise as polar ice is melted. A total melt of the Greenland Ice Cap would raise the level of the oceans over 20 feet. The Antarctic Ice Cap has 9 times as much ice as Greenland.

### Quantities of water:

Total water on earth is about 326 million cubic miles.

Total fresh water is about 3%. (10 million cubic miles.)

Glaciers & Ice fields have about three-fourths of the fresh water.

Antarctica: 7.25 million cubic miles of ice

Greenland: 800,000 cubic miles of ice.

Human body is about 65% water.

Quantity taken in during a lifetime is about 165,000 gallons.

Average use in the home is about 300 gallons a day.

Flush a toilet, 7 gallons

Low flow toilet is 3 gallons

Shower 5 gallons or more

Bath in tub is about 20 gallons.

Elephant is about 70% water.  
Potato is about 80% water.

Characteristics of water:

Weight: about 1 pound per pint (exactly 1 kilogram per liter)

It is not compressible in liquid form.

It turns into a solid at 32 degrees F. (0 degrees C.)

It turns into steam at 212 F (100 C.) at sea level.

At higher altitudes it boils at lower temperatures depending on barometric pressure.

*Convection:* is the process of the flow of water allowing heat to be circulated because water expands as it is warmed, causing vertical circulation.

*Capillary Action:* is the action of a liquid on a solid surface to move to equalize, thus allowing moisture or water to move upward or downward such as the sap in a tree or moisture in the ground.

*Energy Storage:* Water requires 0.25 calorie per pound to raise its temperature 1 degree. It gives off energy in the same amount as its temperature lowers. It requires 135 calories to convert liquid water into vapor. Similarly, it will give off that much energy as it condenses. Ice requires about half as much energy to raise its temperature as water does.

*Expansion:* Water expands as it warms from about 37 degrees.

Water expands as it cools from 37degrees to 32 degrees.

*Impurities:* Most impurities in water, such as salt, are separated from the water as it freezes. Sea ice does not have salt. Water also loses its impurities as it vaporizes.

*Molecules:* are larger than those of alcohol or petroleum products. Fine screens can be used to separate water from these products.

*Osmosis:* is the process of a liquid moving through a membrane into a more concentrated solution, essential for plants.

*Solvent:* Water is often called a universal solvent because of its action with a great number of chemicals and semi-solids.

For a more complete article on the subject, I would suggest either of the following:

*Weather:* Smithsonian

It has comprehensive sections on Erosion, Ice, and water itself.

*Worldbook:* World Book, Inc.; Chicago, IL.; London, England

Subjects:

Erosion

Ice

Steam

Water

Weather

## WEATHER

Weather is like a great dynamic machine. The sun provides the energy as it heats the air and stores great amounts of energy in the water. As the water warms, it evaporates more easily. Water absorbs and stores enormous amounts of potential energy as it evaporates. The warmer that air is, the more water vapor it can hold. Warm air expands and is lighter than cold air so it rises. As it rises it cools and form clouds of very fine droplets of water, forming clouds. If cold air, as in a cold front, hits this warm air, rain will result. As water condenses, it releases large amounts of energy to the air. If the warm air contains large amounts of water and the cold front is extensive, storm cells will form that may cause cloudbursts of rain, high winds, and tornadoes. The best example of this is in the warm moist air flows to the Northwest into the states of Kansas and Oklahoma. As cold, dry winds blow off the mountains and collide with the warm winds, and as they rise, they form a low front, accelerating the flow of cold air. The meeting of these fronts creates an area called "Tornado Alley".

Fine particles of solids perform an important function. Each drop of rain has a tiny particle of solid in its nucleus. Without dust, rain would accumulate in the clouds to the saturation point. As the air cooled after the heat of the day, the clouds would release the water in freshets. A controversial practice of seeding clouds with fine particles of silver iodide to encourage rain in certain areas. People in adjoining areas protested because the clouds hold just so much water.

The air over the Sahara is very hot causing it to rise, forming a low pressure area that causes cool winds to blow off the cold waters of the Atlantic; thus creating dry winds to blow eastward over the Sahara. The very expanse of the Sahara, with very little moist wind, has created the largest desert in the world.

*El Nino:*, a large body of warm water in the Western Pacific, moves eastward in some years, creating a large, almost ocean-size, body of warm water off the coast of Peru. This great heat sink of energy seems to affect the weather over much of the Southern Hemisphere, including large areas of drought in Africa. It was recorded as far back as 1570. Unusually large El Ninos occurred in 1982 and 1983, causing severe droughts in Australia and Indonesia. The Northern Hemisphere is also affected.(c)

*La Nina:*, is a large area of cold Pacific water that rises to the surface off the coast of Peru in the absence of an El Nino. This cold water will release much less water to the air, which will, in turn have much less potential for rain and storms than at other times.

The windward side of a mountain range will have more snow and rain than the leeward side because the slopes force the air upward, cooling it and as the air cools, it releases the moisture in the form of rain and snow.

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(a) "Werner's Universal Encyclopedia" 1890, Volume 5,, The Saalfield Publishing Company, Akron, Ohio "Iceberg" pp 3334=33365

(b) "World Book" Volume 2; 1993; World Book, Inc.; Chicago, Il.; "British Thermal Unit" p 652© Ibid., Volume 6, "El Nino", p 246.

## CLIMATE

*Climate may be defined as the average weather pattern by season, over a large number of years.*

Climate, in the academic sense, is an equation in which the factors are composed of the following; latitude, mountain ranges, large bodies of water, and large areas of land.

*Latitude:* The sun is the source of virtually all energy that is received by the earth. The latitude of the area determines the amount of sunlight per square foot of the earth at any point on the globe. At 45 degrees of latitude the earth will receive about 70% as much sunlight as on the equator. At the Tropic of Cancer or Capricorn the earth will receive about 91%, and at 60 degrees of latitude the earth will receive about ½ as much sunlight as at the equator. (See "Sun" page 15) The amount that is utilized will be affected by the surface of the area. Snow will reflect as much as 93% of the sunlight received.

*Altitude:* Distance above sea level has the effect of being colder than at sea level.

The orderly scope of climate is heavily dependent on ocean and air currents that transport heat from tropical areas to the upper latitudes. The absence of these currents would create large areas of cold in the upper latitude akin the ice Ages. Air and water movement controls rain patters. El Nino is driven across the ocean from the seas near Indonesia to the coast of Peru, changing rain patterns on both sides of the Pacific Ocean..

## CONTINENTS & OCEANS

### CONTINENTS & CLIMATE AREAS (a)

	<u>Sq. miles</u>	<u>Sq. Kilometers</u>
ANTARCTIC	5,540,000 sq miles	14.4 million
ARCTIC	various islands	
AFRICA	11,699,000 sq. miles	30.30 million
ASIA	18,665,000 sq. miles	46.31 million
AUSTRALIA	2,978,000 sq. miles	7.71 million
EUROPS	4,051,000 sq. miles	10.49 million
NOORTH AMERICA	9,348,000 sq. miles	21.12 million
OCEANA-WORLDWIDE	various islands	
SOUTH AMERICA	6,685,000 sq. miles	17.31 million

Oceans cover 65 % of the Earth's surface. They also store much of the heat from the Sun. Their currents distribute that heat worldwide. That heat also has the potential for storms because of the stored energy.

OCEANS & SEAS	SQ. MILES	AVERAGE DEPTH (FEET)	GREATEST DEPTH (FEET)
ATLANTIC	31,529,000	12,880	30,150
ARCTIC	5,514,000	4,200	17,500
BALTIC SEA	155,000	221	1,400
BLACK SEA	168,000	4,300	7,362
BERRING SEA	878,000	1,600	13,620
CARIBBEAN SEA	750,000	8,400	17,360
EAST CHINA SEA	480,000	610	8,920
GULF OF MEXICO	700,000	4,700	12,620
HUDSON BAY	472,000	440	846
INDIAN OCEAN	25,351,000	13,000	24,444
JAPAN, SEA OF	405,000	4,835	13,241
MEDITERANEAN SEA	1,124,000	4,800	15,504
NORTH SEA	221,000	180	2,150
OKHOSK SEA	582,000	3,000	12,620
PACIFIC	65,945,000	14,040	37,752
RED SEA	178,000	1,490	9,300
SOUTH CHINA SEA	895,000	5,400	16,456
YELLOW SEA	480,000	160	348

Note: Various sources do not agree on exact sizes. The listing and physical limits of the Southern Ocean is a point of debate. A few question the designation. Most have agreed on the 60<sup>th</sup> meridian as the limit of the Southern Ocean.. Some argue for the 50<sup>th</sup> and even the 35<sup>th</sup> meridian. In the appendix, I show comparative quotes on the size of Oceans. (b)

## AFRICA

**LOCATION:** It is located in the central area of the African Plate. To the East is the Indian Ocean and to the West is the Atlantic Ocean. In the North, is the Mediterranean Sea. The Equator is slightly South of the Middle of the Continent.

**SIZE:** Total Area; 11,699,000 sq. miles; (30.3 sq. km.)

Average altitude,

Greatest distance, North-South, 5,000 miles (8,0050 km)

East West, 4,700 miles (7,570 km)

Highest point, Mt. Kilimanjaro, Tanganyika, 19,340 feet (5,895 m)

Lowest Point, Lake Assad, Djibouti, 509 feet (104 m) below sea level.

**TOPOGRAPHY:** The major part of the continent is over 1,000 feet (305 m) above sea level so the only river that is navigable for any distance is the Nile R.

Deserts: Sahara in the Tropic of Cancer, 3,500,000 square mi/s (9,000,000 sq km)

Kalahari in the Tropic of Capricorn, 220,000 sq. mi.(570,000 sq km)

Much of the area surrounding the deserts is "Savanna" land that is suitable for grazing and has annual rainfall of 10 to 20 inches. The Savanna is subject to periodic prolonged droughts with attendant famines. All of North Africa except the Mediterranean coast is either Savanna or Desert. Over 95% of the population in Egypt lives within 5 mile of the Nile. The rest of the country is desert..

Much of Central Africa is Savanna or high plateau. Much of Africa is subject to periods of drought. In Chad, a drought may last 20 years.

**Great Rift Valley:** The Great Rift Valley is the result of the gradual separation of a small sector of the African Plate from the rest of the Continent at about a few inches a year. This process will take perhaps millions of years before the sea finally separates the two areas.

### MMOUNTAINS AND HIGHLANDS

Atlas Mountains: N. Africa in Morocco and Tunisia

Drakensberg Mountains in S. Africa

Tibesti Mountains in Chad

5 lesser ranges are listed in *List of Mountain Ranges – Wikipedia*

### LAKES

Lakes	Sq. Miles:	Sq. Km.	
L. Albert	1,640	4,247	Uganda & Zaire
L. Chad	6,800	17,612	Chad, Nigeria
L. Edward	856	2,200	Uganda & Zaire
L. Nyasa	11,100	26,740	Malawi & Mozambique
L Rudolph	3,500	9,065	Kenya
L Tana	1,200	3,100	Ethiopia
L Tanganyika	12,950	33,540	Burundi & Tanzania
L. Victoria	26,828	69,484	Kenya, Tanzania & Uganda



## RIVERS

**Congo:** has the second highest volume of water flow of any river in the world.

The upper Congo is the major source for transportation Congo (Zaire).

**Niger:** Its length is 2,668 miles (4,295 km) and flows into the Atlantic. It is the second largest river in Africa. 1,600 miles (2,580 km) of the upper river is navigable

**Nile:** It is the longest river in the World with its flow (the White Nile) beginning in Lake Victoria, Uganda.

The Blue Nile head waters are in Ethiopia. It joins the White Nile at Khartoum, Sudan. The annual flow is at least twice that of the White Nile.

## ANTARCTIC ©

### AREA:

Total area is 5.4 million square miles (13,986,000 sq. km.). Average elevation is over 7,000 feet (2,100 n.) The greatest distance is 3,450 miles (5,560 km.) from Antarctic Peninsula to Wilhelm II Coast. The highest point is Vincent massif at 16,816 feet (5,125 m.).

### ICE AND WATER:

Average depth of the ice cap is 7,085 feet (2,158 m) in thickness & covers 98% of the continent. The thickest spot of ice is 15,700 feet (4,769 m.). Its volume is about 7.25 million cubic mile, (30,2 million cubic km.), enough, if melted, to cover the entire world with 200 feet of water. The weight of the ice cap causes iced to move toward the coast as much as 60 feet a year.

A lake the size of Lake Ontario has been discovered under about 2.5 miles (4 km) of ice.

### LAKES”

All lakes are subglacial; most of them being over 2.5 miles (4 km) below the surface. At this writing (2008), over 145 lakes had been located. They are located through a form of radar from the air. The largest of these is Lake Vostok. Lake Vostok is about the size of Lake Ontario and lies under 2.5 miles (4 km.) of ice sheet. (h) (*See lakes, Vostok*)

### WEATHER:

Temperatures rarely go over 32 F. (0 C.) and the coldest recorded temperature was -128 F (-89 C.), the coldest ever recorded. Average precipitation is less than 8 inches (20 cm.) per year. In terms of precipitation, it is the largest desert on earth.

### POLITICAL:

A treaty, in effect since the 1960's, was signed by 45 nations who had interest in the area. Under the treaty, activity is to be limited to scientific study. A number of nations have laid claim to areas of the continent for exploitation but activity has been limited to scientific observation. The United States has maintained year-round facilities at Little America.

### RESOURCES:

There is evidence that coal and oil as well as many minerals, are present in Antarctica.

### GEOGRAPHY:

Tectonic plate: The Antarctic tectonic plate extends beyond the continent on all sides. It continues to grow as all other plates adjoining it are moving away or laterally at about 4 inches per year.

### MOUNTAIN RANGES:

Queen Maud Range  
Sentinel Range

## ARCTIC REGION

### LOCATION:

It is the area North of 66 deg., 30 min. N. (No of the Arctic Circle).

### SIZE:

The boundary of the Arctic is marked by 50 degree F. summer average (10 C.) and forms an irregular line. Size is difficult to measure. The size of the Arctic is shrinking as the World warms.

### TOPOGRAPHY:

ARCTIC OCEAN: 5.44 million sq. miles. (14.09 million sq km)

GREENLAND 836,350 sq miles.(2,166,146 sq km) Pop (2004) 56,676

The island area is mainly of permafrost, ice caps, & tundra or taiga. Greenland has approximately 800,000 cubic miles (3,354,0000 cu km) of glacier ice. Of the total area of Greenland, 158,475 sq miles (411,150 sq km) is free of ice.

The climate of Greenland: July temperatures average below 50 deg. F. (10 deg. C.). It is above the tree line. During the Little Ice Age (1,300 to 1,800 A.D., the population died out and the land became uninhabited.

BAFFIN ISLAND: It is 193,922 sq. miles (51,598 sq km), about the size of California. It lies North of the 65<sup>th</sup> parallel. The island is 700 miles (1,100 km) long and extends across the entrance to Hudson Bay. It is the largest of the islands of Northern Canada.

The areas North of the Arctic Circle also includes parts of Alaska, Siberia, Norway, Canada, and Iceland. These areas are characterized by permafrost, tundra and treeless areas. The Brooks Range in Alaska and the Aleutian Islands mark the southern boundary of the Arctic. (d) .

## ARCTIC OCEAN

### GENERAL:

The Arctic Ocean lies North of Canada, Greenland, and Asia. Most of the Ocean is covered by a permanent ice field. The areas along the continents are navigable from June through October. It is believed that by 2050, the Ice field will be seasonal.

### SIZE:

It covers about 5,400,000 sq. miles (14,000,000 sq km). The ocean is broken up by islands and bays. Its greatest length is about 2,650 miles (4,190 km) and its average depth is 3,950 feet (1,200 m). Its greatest depth is 17,800 feet (6,035 m).

### CLIMATE:

Average temperatures range from -28 F (-33 C.)in January to about 29 F (2 C.)in July.

### WATER CURRENT:

Water flows into the Arctic Ocean through the Bering Straits and the straits East of Iceland from the Atlantic Ocean and flows out through the Greenland Strait and the Davis Strait.

## OCEAN LIFE:

It includes seals, whales, and fish. Phytoplankton thrives in the water and is the basic food in the food chain. (e) See: "Oceans)

## ASIA (g)

**LOCATION:** It is the major part of the Eurasia continent.. It includes  
**SIZE:** 18,665,000 sq. miles (48 million sq. km.) East-West, 6,000 miles (9,600 km.); North-South, 5,400 miles (8,600 km.)

**TOPOGRAPHY:** Siberia is relatively flat with cold winters and a number of large rivers flowing north into the Arctic Ocean. Many of these rivers freeze solid during the winter. Central Asia has many mountains and several large areas with little rainfall because of the large mountain ranges that keep rain clouds south. Several areas have large deserts such as the Arabian, Gobi and the Iran deserts. South of the Himalayas the monsoons bring seasonal rains to the South. An exception is the valley of the Indus, which is a desert area.

Collision between the Eurasian and Indian subcontinent plates has created a number of high mountain ranges including the Himalayas.

## MOUNTAINS

Himalayas:

Urals:

Wikipedia lists over 50 mountain ranges in Asia.. Many such as the Caucasus, The Japanese Alps and the Urals are noteworthy. See *mountain ranges*

LAKES	SQ. MI.	SQ. KM.	COUNTRY
Aral Sea	26,523	68,900	Kazakhstan & Uzbekistan
L Baikal	12,160	31,500	Siberian Russia
L Balkhash	6,670	17,280	Kazakhstan
Caspian Se	151,823	393,200	Russia, Turkmenistan, Iran, Azerbaijan,
Dead Sea	400	1,036	Israel & Jordan
L Koko Nor	2,400	6,215	China
L Ladoga	7,104	18,400	Russia

Further text is in section on lakes.

## MAJOR RIVERS:

Amur	2474 miles	3,980 km.	Russia
Ganges:	1500 miles	2,413 km.	India & Bangladesh
Indus:	1880 mile	3,024 km.	Pakistan & Tibet
Lena	1661 miles	2,579 km.	Russia
Ob	3461 miles	5,567 km.	Russia
Yangtze:	3480 miles	5,599 km.	China
Yellow:	2900 miles	4,660 km.	China

Further text is in section on Rivers.

## **AUSTRALIA**

Australia is both an island continent and a country. The Australian Plate includes Tasmania, which is separated from Australia by a shallow sea that was a land bridge during the last ice age. (a)

**LOCATION:** It is south of Indonesia between the Pacific and Indian Oceans.

**SIZE:** 2,988,902 sq. miles (7,741,256 sq. km.) It is about 2,400 miles (3,800 km.) east to west and 1,600 miles (2,600 km.) north to south.

**TOPOGRAPHY:** The land is sandy and dry with low mountains in the northwest and east. A unique feature is the Great Barrier Reef, just off the east coast. In the south, Tasmania (a large island) lies across a shallow stretch of the South Ocean.

The great Australian Basin is 676,250 sq. miles (1,175,400 sq km.) . It is the largest basin in the world. Only 6% of Australia is above 2,000 feet (600 m.) Most of the continent is either desert or steppe. The east and south have more rain and the far north is subtropical. (b)

**TASMANIA** Island 150 miles (240 km) south of the eastern part of Australia. The land area is 25,606 sq mi (68,401 sq km). It is 226 miles (64 km) from North to South and 190 miles (306 km) from East to West. The land is quite rugged and the climate is temperate.

## CENTRAL AMERICA & CARIBBEAN

**LOCATION:** The seven countries of Central America are located on a land bridge between South America and Mexico.

**SIZE:** 201,350 sq miles (521,499 sq km.)

**TOPOGRAPHY:** Central America is on the western edge of the Caribbean plate, which is in collision with the Nazca plate. As a result the area is subject to both earthquakes and volcanic eruptions. The Caribbean countries are subject to devastating hurricanes. Partial deforestation was partly responsible for the devastation that crippled Honduras when it was hit by a hurricane in 1995.

**LAND USE:** Arable land is 10.5%; permanent crops, 2.5%; pastureland, 27.5%; forest, 27.7% and other (mountain peaks and swamps), 21.6% (*compiled from the Handbook of the Nations*)

The area is overpopulated and many people have emigrated to the United States for work to support their families. (See Book II *Profile of the Nations*..)

The Caribbean Sea is a sea of 1.1 million sq miles (2.85 million sq. km.) It is bordered on the west by Central America, the south by South America and the north and east by the Caribbean Islands, a line of 7,000 islands, islets, reefs and cays forming a chain 2,500 miles (4,020 km.) long and not more than 165 miles (257 km.) in width, some coral and some volcanic. The islands are organized into 28 territories and sovereign states

Among sovereign countries are Cuba, Jamaica, Haiti, Dominica, Granada, and Hispania.

*(Caribbean – Wikipedia)*

## EUROPE

**LOCATION:** Europe is the western part of the Eurasian Continent, a line drawn at approximately the 60 meridian. A number of countries including Russia are in Europe and Asia.. Physical boundaries are the Arctic Ocean in the north, the Atlantic Ocean in the west, the Mediterranean Sea and Black Sea in the south and the Ural Mountains in the east.

**SIZE:** Total area is 4,051,000 sq. miles (10,493,000 sq km.)

**TOPOGRAPHY:** includes many large peninsulas such as the Iberian (Spain and Portugal), the Scandinavian (Sweden & Norway), Italy, and Greece. Many political boundaries are also geographic, the Pyrenees between Spain and France, The Alps separate several countries, and the Caucasus, between the Black Sea and Caspian Sea, form a southern boundary for Russia.

**Mountain Ranges:** Alps, Caucasus, Ural, Pyrenees, , and the Urals are among the major mountain systems.

Rivers include the Danube, Rhine, Rhone, Seine and Volga.

The climate ranges from balmy along the Mediterranean Sea to the Arctic Ocean with long, harsh winters. Rainfall is moderate in most areas.

The Mediterranean Sea has many major islands such as Sicily, Crete, Cyprus, and innumerable islands in the Greek Archipelago.

## NORTH AMERICA

**LOCATION:** It is between the Atlantic and Pacific oceans from Latitudes North 15 degrees to North 86 degrees (North Islands). The mainland extends to latitude 75 degrees N.

**SIZE:** 9,348,000 SQ MILES. (24,210,000 sq. km.)

**TOPOGRAPHY:** Most of the continent is relatively flat with mountains in the East and West. In the east are the Appalachian range, a very old formation, separated from the Atlantic by a coastal plain that has low ridges. The central plains include the Mississippi watershed and the Great Lakes draining into the St. Lawrence.

The Rocky Mountains extend from Mexico to the Arctic, separated from the Pacific Ocean by the Great Basin and by narrow valleys in the north. The Coast Ranges are very close to the ocean with very narrow coast areas except the valleys formed by the rivers that pass through the mountains, namely the Fraser, Columbia, and the Sacramento.

**Mountain Ranges:** Appalachian Mountains: They extend about 1,500 miles from Birmingham, Alabama northeast to the Gaspé Peninsula in Quebec, Canada. They are the oldest mountains in North America.

Mountain Ranges include the Cascades, Coast Range, Rocky Mountains, the Appalachian Range, and the Laurentians.

Major river systems, include the Columbia, Colorado, Mississippi, St. Lawrence, Frazer, Sacramento, Mackenzie, and Rio Grand.

North America has a large number of major lakes; Erie, Great Slave, Huron, Michigan, and Superior. There are a number of other large lakes in Canada.

## OCEANA (PACIFIC ISLANDS)

**LOCATION:** With the exception of New Zealand and the Hawaiian chain of islands, most island groups are south of the Equator and in the West Pacific. See book 2, Appendix B for listings by area.

**NEW ZEALAND:** is part of the Australian Plate and along the edge of the South Ocean.

**HAWAII** is in the Eastern Pacific. Taiwan is considered as a boundary nation..



## SOUTH AMERICA

**LOCATION:** It is between the Pacific and Atlantic Oceans and ranges from Latitudes N 12 degrees to South 58 degrees.

**SIZE:** 6,685,000 sq. miles (17,314,000 sq km)

**TOPOGRAPHY:** The east has no major mountains. The land is flat in the Brazilian Amazon area and the Platte watershed lowlands. The land rises to a plateau that includes the Patagonia, part desert and part steppe. The Andes Mountain Ranges extend from Cape Horn in the south to Columbia where it splits into 3 ranges to the Caribbean Sea and Isthmus of Panama.

**Mountains:** Andes Mountains: They are the longest mountain chain above sea level at 4,500 miles (7,240 km). They average 400 miles (640 km) deep. The Andes are a result of subduction of the Mazco Tectonic Plate beneath the South American Plate, forcing the land up and creating the Andes through both upthrust and volcanic action. Many mountains are over 20,000 feet (6,090 m) in elevation.

<u>Rivers</u>	<u>Location</u>
Amazon River:	Peru, Brazil
Parana /River	Argentina, Brazil
Sao Francisco River	Brazil
Uruguay River	

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- (a) 1 "Australia" World Book Encyclopedia Vol. 1 (A) pp 894-922
  - (b) *Australia*, Encyclopedia of the Nations, Volume 4.
  - (c)

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- (a) *Great World Atlas, 1963*, Readers Digest Association, p 152..
  - (b) *Ibid*, p. 152.
  - (c) *Worldbook, 1993*, Volume 1, "Antarctica" pp530-539.
  - (d) *Worldbook, 1993*, Volume 1, "Arctic" pp636-640.
  - (e) *Ibid.*, "Arctic Ocean" pp 641-644
  - (f) *Ibid*, "Africa", pp 98-136.
  - (g) *Ibid*, "Asia", pp 770-812.
  - (h) *National Geographic, Internet, Antarctic Lakes*.
  - (

## DESERTS (a)

Deserts cover about 16 million square miles of the land surface of the World. Deserts are classified as areas with an average of less than 10 inches of rainfall per year. Deserts vary from mountains and rocky plateaus to desert vegetation and sand dunes. Less than a fourth of desert land is sand dune. In a few areas, sand dunes may be up to 700 feet (210 m) in height. Most deserts straddle either the tropic of Cancer or Capricorn.

*Koppen Range* Under the Koppen Range, deserts are those areas with less than an average of 10 inches of rain per year and with high temperatures. Semi-arid areas are those with an average of between 10 and 20 inches a year. *Savanna* areas are grasslands with from 10 to 50 inches of rainfall a year. Semi-arid lands are often referred to as *Savanna*. *Steppe* areas are usually semi-arid areas that have from 10 to 20 inches of rain per year and have hot summers and cold winters. Arid areas may have limited use in grazing animals. Semi-arid lands may have grass and grains that are resistant to drought. Many semi-arid areas are subject to periodic drought with periodic famines.

Antarctica has less than 10 inches of precipitation and is often referred to as the largest desert in the world.

Many desert areas are suitable for limited use as pastureland. Many *steppe* are used for dry-land farmland. Much of the land East of the Rocky Mountains (the high plains) is used for production of grains such as wheat, barley, and oats.

Two-thirds of Africa is classified as *Savanna* some of which adjoins the Sahara Desert and is subject to long periods of drought and is threatened by desertification.

About 14% of the land area of the Earth is desert and about the same amount is classified as semi-arid.

## DESERTS IN GENERAL

Deserts are caused by certain geographic factors. The deserts are both alike and different in the factors that cause them.

1. An area of high degree of sunlight. Most of the major deserts are on or near the Tropic of Cancer or Capricorn except one. The Arabian, Australian, Kalahari, African-Peruvian, and Sahara deserts actually straddle Tropic of Cancer or Capricorn. Both the Iranian and Indian deserts are near the Tropic of Cancer.
2. Mountain barriers that prevent moist air from reaching areas: This is true of the Iranian, North American, Patagonia, Taklamakan and Turkestan deserts.
3. Cold ocean water offshore: North American, Atacama-Peruvian, Sahara, Patagonia, and Kalahari deserts.
4. Hot, dry winds: North American, Australian, and virtually all the Asian deserts.

5. Interior Basins (Endothermic) form the setting for several deserts. Examples are the *Great Basin* in Nevada which contains a part of the Great American Desert and the *Tarin Basin* which contains the Taklanakan Desert. Global warming is a factor discussed in a section on Global Warming.

### MAJOR DESERTS

(List of Deserts - Wikipedia)

Antarctic Desert	5,400,000 sq. miles	(14,000,000 sq. km.)	(1) largest
	All of Antarctica		
Arabian:	900,000 sq. miles	((2,300,000 sq. km.)	(3)
	Smithsonian, same		
	Arabian Peninsula		
Atacama-Peruvian	54,000 sq. miles	(140,000 sq. km.)	(20)
	Smithsonian	40,000 sq. mi.	105,000 sq. km.
Australian	1.300,000n sq. miles	3,400,0000 sq. km.	
	Central Australia		
	Great Sandy	150,000 sq. mi.	400,750 sq. km. (9)
	Tanami	71,,00 sq. mi.	184,500 sq. m.
	Great Victorian	250,000 sq. mi.	6447,750 km. (6)
	Gibson	60,200 sq. mi.	145,500 sq. km. (18)
	Simpson	50,600 sq. mi.	145,500 sq. km. (119)
	Other deserts (7)	270,700 sq. mi.	761,275 sq. km.
Gobi	500,000 sq. mi.	1,300,000 sq. km.	(4)
	Mongolia and China		
Iranian	150,000 sq. miles	390,000 sq. km.	
	Iran		
Karin	100,000 sq. mi.	250,,000 sq. km.	(15)
Kalahari	100,000 sq. miles	260,000 sq. km.	(14)
	Botswana, Namibia, and South Africa		
	(Smithsonian <i>Earth</i> )	275,000 sq. mi.	712,000 sq. km.
Kara Kum	135,000 sq. mi.	350,000 sq k	(10)
	(Smithsonian)	115,000 sq. mi.	297,000 sq. km.
	Turkmenistan		
Kyzyi Kum	115,000 sq/ mi.	300,000 sq. km.	(12)
	Kazakhstan, Uzbekistan, and Turkmenistan		
North American	500,000 sq. miles	300,000 sq. km.	
	Smithsonian <i>Earth</i> :		
	Great Basin	190,000 sq. mi.	492,000 sq. km. (7)
	Sonora	120,000 sq. mi.	310,000 sq. mi. (11)
	Mojave	54,000 sq. mi.	140,000 sq. km. (22)
	Chihuahua	200,000 sq. mi.	518,000 sq. km. (8)
Namib (Smithsonian)	80,000 sq. mi.	310,000 sq. km.	(21)
	Namibia		

Patagonian	260,000 sq. miles	675,000 sq. km.	(5)
Smithsonian	same area		
	Argentina and Chile		
Sahara	3,500,000 sq. miles	9,100,000 sq. km.	(2)
Smithsonian	Same area		
	All North African countries		
Syrian Desert	100,000 sq. mi.	260,000 sq. km.	(16)
	Syria, Jordan, and Iraq.		
Takla Makar (Smithsonian)	120,000 sq. mi.	327,000 sq. km.	
Takiamakan	105,000 sq. miles	270,000 sq. km.	(14)
	Sinkiang province of W. China		
	See text on Gobi		
Thar	77,000 sq. miles	200,000 sq. km.	(17)
Smithsonian	<i>Earth:</i> 172,000 sq. mi.	440,000 sq km	
	Pakistan & SW India		

A major feature in many deserts is the oasis, a depression in which the land level is below the water table level, and there will be pools of water. In some cases, the oasis is below sea level and the sea is actually driving the water upward. For more on individual oases, see the section after the one on deserts.

Among the driest areas of the world are Arctic and Antarctic landmasses that receive less than 10 inches of rainfall, i.e. Siberia, northern Finland, Canada, Alaska, and the Antarctic continent.

## **ARABIAN DESERT (900,000 sq. miles)**

*(Arabian Desert – Wikipedia)*

The Arabian Desert. 900,000 sq. miles, (2,300,000 sq. km) it is half again as large as Alaska. It stretches from Yemen to the Gulf of Persia, Oman to Jordan and Iraq. It is a vast wilderness that covers nearly all of the Arabian Peninsula. There are no rivers in the desert because none of the mountains receive enough rainfall for a steady runoff. About 1/3 of the desert is covered with sand, a greater percentage than any other desert.

The Al Hilaz Mountains separate the desert from the Red Sea. The Paramount Highlands separate it from the Gulf of Aden. The Tigris-Euphrates river system separates it from the Iran Desert. To the North is the Syrian Desert. A great depression called the Jabal Tuway separates the desert into two areas.

Extremely low rainfall and the range of temperatures from freezing to over 120 F. (over 50 C.) renders the desert one of the least hospitable of deserts. In the area near the Red Sea there is farming and grazing land. (“Arabian Desert,

The Eastern Desert is extremely rich in petroleum; however the 1991 war has left the area seriously damaged by oil spills, areas of mixed sand and oil and the debris of war included depleted uranium used by the Allied forces. (*www.Wikipedia*)

Al-Hasa Oasis, Saudi Arabia

Al-Qualf Oasis, Saudi Arabia

Qatif Oasis, Saudi Arabia

## **ATACAMA-PERUVIAN DESERT (140,000 sq miles)**

*(Atacama Desert – Wikipedia)*

The Atacama-Peruvian desert extends for about 600 miles (960 sq. km.) between the Andes and the Pacific Ocean of Peru and northern Chile.

The desert is the driest in the world. Much of it averages less than half an inch (10 mm.) per year and certain areas have no record of rainfall in centuries. Much of it is blocked between the coastal range and the Andes from moisture from the west and from the east. Some weather stations have never recorded rain.

Some mountains that reach as high as 22,500 feet (6,885 m.) are completely free of glaciers because of lack of precipitation. Two observatories have been established on the Atacama because of the extremely clear atmosphere created because of virtually no cloud cover and a lack of pollution.

Mines have been developed to recover rich deposits of minerals and nitrates. Many towns have been abandoned as other sources for nitrate have been found or developed.

Controversy between Bolivia, Peru and Chile began in the 1800's and borders are still under dispute.

Huacachin Desert, Peru

San Pedro de Atacama

See also *Atacama Desert National Geographic Magazine - Internet*

## **AUSTRALIAN DESERT (1,300,000 sq. miles)**

*Deserts of Australia – Wikipedia)*

*(Australian Desert – Internet)*

Most of the island continent of Australia has less than 20 inches of rainfall

The Great Australian Desert, 1,300,000 sq. miles (3,400,000 sq. km.) occupies the central and western part of Australia. Geographers have divided the Australian Desert into 11 different areas, the largest of which is the *Great Victoria Desert*, the sixth largest desert in the world. The Great Australian Deserts occupies about 44% of the continent, and is surrounded by large semi-arid areas. It is covered by scrub and sparse grasses.

The desert on the northwest is known as *The Great Sandy Desert* and the one to the South and Southwest is known as *The Great Victorian Desert* Much of that land is leased or owned by great ranches. This land has sparse vegetation. An acre in Scotland (0.4 hectares) might support a sheep. In Australia, it might take a hundred acres.

The central part of Australia is mostly plains with highlands (The Macdonald Range) in the center. The Great Divide Range extends North to South back of the Eastern shore. To the west of that is the Great Divide Basin. The Highlands are inland from the coast virtually encircling the interior of Australia, Most rains never reach the interior. To the west of Australia is a relatively cool Ocean. Since cool water does not readily evaporate, the winds that cross the continent have low humidity., thence the large arid and semi-arid landscape.

## **GOBI DESERT**

*Gobi Desert – Wikipedia)*

The Taklamakan Desert 200000 sq mi. (520,000 sq. km) clearly a separate desert is included in the area figures for the Gobi.

“Gobi is a windswept, nearly treeless desert and steppe area that stretches across part of southern Inner Mongolia (an autonomous region of China) and northern China. The Gobi covers more than 500,000 sq. miles (1,300,000 sq km.). It stretches about 1,200 miles (1,930 km.) from east to west and about 600 miles (970 km.) from north to south. The Gobi lies in a basin on a high plateau. Elevations in the desert range from 3,000 to 5,000 feet (910 to 1,500 meters).”(b)

To the north lie the Yablunoi, Altay, and Sayan mountain ranges; to the southwest is the Qillan range; the southeast and separating it from the Tibetan Plateau are the Kunlun Shan, and Altun Shan.

Much of the Gobi is steppe, (dry grassland). The temperatures reach a high of 120 F. (50 C.) in summer and a low of –40 F. (-40 C.) in winter. . The Lop Noir and Tarin basins are part of the Gobi. (*“Gobi Desert”, Wikipedia)*

## **IRANIAN DESERT (150,000 sq miles)**

*(Iranian Desert – Tagzania, www)*

The Iranian desert (in old Persia) at 150,000 sq. miles (390,000 sq. km.) is not a large desert, yet it is larger than the state of Montana.

The Central Persian Desert Basin covers 6830,000 sq miles. (1,640,000 sq km.) and covers the arid steppe and desert region of Central Iran and a small part of northwest Afghanistan. It is dominated by a large salt desert in the north and smaller areas of very hot sand and gravel areas in the east. The plant life varies from sagebrush to salt land and other desert vegetation. *.(www.worldwildlifefund.org)*

The Iranian Desert is well known for the largest sand dunes of any desert, with some as high as 700 feet (210 m). In and near the desert areas are many traces of Neolithic man, the first known agriculturalists. There are signs of later and powerful empires. There is abundant evidence here and elsewhere in the area that man's misuse of the land has desolated many fertile acres, allowing the desert to encroach. The desert is a high plateau with hot summers and cold winters with temperatures as low as 0 F. (-17 C.) The plateau is almost completely surrounded by mountains, the Elburz to the North, separating it from the Caspian Sea, and the Zacroos on the southwest are the most notable.

*The Iran Nubo-Sindan desert and semi-arid, (Wild world):*

“The desert areas of southern Iran extend from the edge of mangrove and coastal habitat of along the Arabian Gulf, the south, northwest through the salt plains and Iranian Desert to the mountains that rise from it. “ *(Wild world)*

Much of the region is filled with scrub growth, similar to the American southwest. *(Wild world)*

Tabas Oasis, Iran

Note: “Wild world” is a term used by the World Wildlife Fund

**KALAHARI DESERT (220,000 sq. miles) (570,000 sq. km.)**  
(*Kalahari Desert – AOL*)

It is located in northwestern South Africa, southern Botswana and southern Namibia and between the Orange and the Zambezi rivers.

The Kalahari desert lies in southern Africa with a much greater area of grassland blending into it. The Kalahari extends west to the often-foggy coast desert, known as the Namib. For some reason several sources seem to disagree on the size of the Kalahari. One source (Worldbook) lists it at 195,000 sq. miles, and another reports it as 226,000 sq miles. (*Kalahari Desert – Wikipedia*)

The Kalahari is covered mainly by sand colored by iron oxide; Rainfall varies from 5 inch (12.7 cm.) in the southwest where there are active sand dunes to 20 inches (50.8 cm.) in the northeast. Most of it is flat land with many dry lakes that fill during the rainy season. Seasons change very quickly and there are periodic droughts. A great number of species migrate to the Kalahari during the rainy season and go elsewhere during most of the year.

Most of the area has seasonal grass and the Acacia tree is the most common tree. There is brush. Much of the area could be classified as savannah. In most areas the sand dunes are stable with grass covering. One of Africa's largest nature reserves is in the Kalahari.

Winter temperatures can go as low as 7 degrees F. (-14 C.) and daytime 86 F. (30 C.); summer, night low (41 F. (5 C.) day high 113 F. (45 C.)

(*Kalahari Desert – Internet*)  
(*Kalahari Desert – Rome Travel Info. [Internet]*)\_

**KARAKUN DESERT (Kara Kun) area, 107,000 sq miles (350,000 sq km)**  
The desert covers about 70% of Turkmenistan

It is located east of the Caspian Sea with the Aral Sea to the north.. The Murghab and Tejen rivers flow from the Hindu Kush and empty into the desert, providing irrigation. The desert is crossed by the largest irrigation canal in the world, 875 miles long (1,375 km). Water is seeping into the ground, causing a rise in the water table. There are now a number of lakes and ponds along the course of the canal. This is also causing salination of the soil. The desert is home for the Darwasa Gas Crater. (*Karkum Desert – Wikipedia*)

See also: Aral Sea.



**KYZYL KUM 115,000 sq. miles (300,000 sq km)**

Location: Kazakhstan, Uzbekistan, and Turkmenistan

It is in the area between the Amu Darya and Syr Darya rivers.

The desert has many sand dunes. In other areas, desert plants and dry land grass. Native people use it for pasture. The desert is rich in minerals and there is gas and oil..

An animal reserve of 20,000 sq miles (51,450 sq km. has been set aside. It is located about 25 miles (40 km) south of Burkhart. Another nature reserve in Bukhara Province covers 39,000 sq miles. (100,000 sq k.). It is located on flood land.

**NAMIB (80,000 sq. miles) (310,000 sq. km.)**

It is located in Namibia and Angola. It runs for 1,000 sq mi (1,600 sq km) along the Atlantic coast of southern Arican. It is from 30 to 100 miles( 50 to 160 km inland. Average rainfall is .42 inches 10 mm) annually. It is one of the oldest deserts, dating back more than25 million years. The desert is barren.

**NORTH AMERICAN DESERT (500,000 sq. miles) (1,300,0-00 sq. km.)**

Location: The region covers northeastern South Africa; southern Botswana, and southeastern Namib.

The North American Desert includes various landscapes in the southwestern United States and northwestern Mexico, with four major divisions; the Great Basin, the Mojave, the Sonora, and the Chihuahuan deserts.

**GREAT BASIN:** The area includes part of SE Oregon, a portion of Southern Idaho, SW Wyoming, all of Utah except the Wasatch Mountains, almost all of Nevada except a part of the South that is classified part of the Mojave, and a small corner of Northern Arizona.

Most of the Great Basin, names for the basin between the Rockies and the Sierra Nevada-Cascade ranges, is steppe or semi-arid. In southern Nevada and southwest Utah, it is a true desert, including the Great Salt Lake Basin, merging gradually with the Mojave of southeastern California. The Mojave is a small transition area between the Great Basin and the Sonora Desert to the south. Much of the Great Basin is an inland basin, made up of many smaller basins, each without an outlet. The Great Salt lake Basin, a part of the Great Basin, is also an inland area without outlet to the Pacific. It is an almost treeless range of broad valleys, rugged Ranges and soaring peaks.

Also see *Lake Tahoe, Pyramid Lake, and Great Salt Lake*

Sage, yucca, and low plants are typical of much of the desert.

Salt Lake City, Utah and Reno, Nevada are in the Great Basin. Over ½ million people live in the Salt Lake area.

Bryce Canyon, Zion, Capital Reef, and Glen Canyon are in the Great Basin

*(Great Basin – Wikipedia)*

**MOJAVE DESERT:** The area covers Southern Nevada, and all but a small part of SE California.

Plants include yucca

Las Vegas, with about a million people is in the Mojave.

Death Valley and Joshua Tree National Park are in the Mojave.

**SONORA DESERT:** The area includes a tip of SE California, SW Arizona most of the Baja Peninsula, and the Western part of Sonora, Mexico.

The Sonora Desert stretches from southeast California, across southern Arizona and the southwestern corner of New Mexico on into Sonora and Baja California.

National Parks: Bryce Canyon, Zion,

Phoenix and Tucson are in the Sonora.

Typical plants are saguaro cactus, cholla cactus, yucca, and organ pipe cactus. On the Southern Baja is the creeping devil cactus.

**CHIHUAHUA DESERT:** The Chihuahua Desert lies to the east of the Sierra Madre Occidental system, spreading north to the southwest corner of New Mexico, SW Texas, and the southeast corner of Arizona.

Plants include yucca

El Paso is in the Chihuahua.

Big Bend N.P, Guadalupe Mountain, White Sands and Amistad are in the Chihuahuan Desert.

**ORDOS DESERT area is 35,000 sq nuke (90,6650 sq km)**

It covers the southern section of Inner Mongolia.

The Ordos Desert is separated from the Gobi by a range of mountains. It lies on a plateau. The soil is a mixture of clay and sand and does not lend well for agriculture. In the South, the desert rises to 4,900 feet (1,500 m.). The desert forms a step from the Himalayan Mountains to the lowlands of East China.

The Desert receives less than 10 inches (25 cm) of rain a year. There are small farms in the oases. Much of the land is grazed by herds of sheep and goats. Overgrazing is causing some desertification.

Strong north and west winds are common. Much of the moisture comes during thunderstorms. Winter temperatures are commonly 10 to 15 degrees F.

(-10 to 1-5 C). (*Ordos Desert – Wikipedia*)

**PATAGONIAN DESERT 260,000 sq. miles) (675,000 sq. km.)**  
(*Patagonia Desert – Wikipedia*)

The Patagonian Desert of Argentina, has a name too well known to be changed but the grassland in Argentina to the north is called the Patagonia and the desert to the south is called the Monte. This desert, east of the Andes is very similar to the Sonora with which they share many plant species.

The Patagonian Desert is found between the Andes Mountains and the Atlantic Ocean in the Patagonian region in Argentina. It is a cold desert with temperatures that average just 38 degrees F. (7 C.) and there is often frost. Before the advent of the Andes mountains, the area was covered with rain forest. There are petrified trees in the middle of the Patagonia. There are sandstone canyons and clay shapes that have been sculpted by the wind. Today people mine for coal and petroleum and raise livestock on the scrubland. (*BBC. Science & Nature – Patagonia, www.*) . .

**SAHARA DESERT (3,500,000 sq. miles) 9,100,000 sq km.)**  
(*Sahara – Wikipedia*)

The Sahara Desert is larger than Canada, The United States, Brazil, or Australia. This article can only hint at the complexity of the desert. The Sahara has many mountain ranges, a myriad of oases, stony plateaus, areas where there is grazing and sandy desert with great sand dunes. Movies depict the Sahara as a sandy waste; yet the sandy wastes cover only a fourth of the desert . Deserts are defined as areas with less than 10 inches of rainfall. This, among other things, gives a great latitude for variety. Over 2,000,000 people live in the various oases of the Sahara. It covers part or most of 10 Nations.

The Sahara is, by far, the largest of the deserts, outside of Antarctica, stretching over 3,200 miles (5,635 km) east-west and 1,200 miles (1,935 km) north-south across northern Africa. It is nearly as large as the 50 states of the U.S. About a tenth of the desert is in sand dunes The Athaggar mountains in Algeria rise to 9,500 feet (2,900 m) and the Tibesti Mountains in Chad reach a height of 11,200 feet (3,420 m). Many of these mountains have snow in season. An area SW of Cairo, Egypt is well below sea level. Some areas to the South of the Sahara, are suffering from desertification because of over-grazing and long-term droughts. Some villages have been overrun by sand dunes.

There are many oases, areas with springs and wells where people live, in some cases large villages and in other cases there are single homes.

About 10,000 years ago, as the ice age ended, the climate changed and large areas that had been farmed and contained lakes, became too dry to farm and the lakes disappeared

Much of the land is rich in oil and natural gas, as well as many mineral deposits. In Libya and Tunisia, there are many producing wells.

Satellite imaging has revealed that the Nile River once flowed West across the Sahara and into the Atlantic Ocean.

## **GEOGRAPHY of the SAHARA: BY AREA, EAST TO WEST.**

### **NORTHERN SAHARA FROM EAST TO WEST:**

**EGYPT:** 386,000 sq miles. (1,000,000 KM) Arid 95%  
Sinai: small, very rugged with mountains up to 8,823 feet (2,629 m.).  
Eastern Desert: is from Red Sea to Nile is very dry with rugged terrain, deep valleys.  
Nile River Valley: narrow, fertile, irrigated, extends from Sudan to the delta on the Mediterranean Se. Cliffs as high as 1,500 feet enclose the river..  
Western Desert: southwest to the Libyan border, plateau with a large number of oases. There is some scrub and firm ground, negotiable by 4 wheel drive vehicles.  
Libyan Desert: is a plateau extending to the Mediterranean Sea, bare sandy with the *Qatara Depression* between it and the Western Desert.  
Great Sandy Desert extends into Libya. It has many sand dunes and virtually no vegetation.. This desert is virtually impassable.

**LIBYA:** 679,000 sq. miles. (1,736,000 SQ KM) Arid, 87%  
*Libyan Desert – Wikipedia)*  
Libyan Desert extends from the Egyptian border to the Algerian border:.. From the coast, the land rises to an escarpment up to 3,300 feet (1,000 m.) high. On the plateau there is scrub and scattered masses of stone. There are a number of oases.  
*Tibesti Mountains* rise up to 7,434 feet (2,266 m.) are in the far south on the border with Chad.  
Gafe Caber Plateau is with sheer cliffs and deep wadis, rises about 1,000 feet (300 m.) above the surrounding sand and is about the size of Switzerland.  
Al Houro includes several oases and silted Desert. *Libya, Wikipedia)*

**TUISIAN:** 63,000 sq miles ((163,200 sq k) arid, 47%  
Sahara: runs along the southern border with the eastern terminus of the Atlas Mountains and a large salt lake. There are a number of oases.

**ALGERIA:** 919,000 sq, miles. (2,380,0000 sq km) Arid, 82% Sahara Desert is at least 80%. The Sahara is in the south with Libya to the east and Morocco and Mauritania to the west.

About a fourth of the desert is covered by areas of sand dunes (called ergs). Much of the rest is made up of rocky plateaus, the Ahaggar and Tassili Mountains Rivers from the south slopes of the Atlas mountains form numerous oases.  
Ahaggar Mountains are in Sahara in southern Algeria. The highest point is 9,373 feet (2,913 m.) Eroded sandstone plateaus surround the mountains.

**MOROCCO:** Area, 172,000 sq. miles 445,000 sq km). Arid, 41%,., pas-  
ture, 28%  
Sahara: *Western Sahara* includes most of the desert area and merging into pasture and some cultivated land along the Atlantic Ocean. (*Morocco – Wikipedia)*

## SOUTHERN SAHARA FROM EAST TO WEST

**SUDAN:** 990,500 sq. miles (2,965,400 sq km). 51%, desert, swamp Nubian Desert (Sahara) extends from the Red Sea, along the southern border of Egypt to Chad on the west and swampland to the south. The land is hilly to the east and undulating to the west with thin soil over rock. *Sudan – Wikipedia)*  
Libyan Desert is sandier and less rugged. *(Libya – Wikipedia)*

**CHAD:** 496,000 sq. miles (1,285,000 sq km). Arid, 51%; pasture 30%  
Sahara: The Sahara includes the Tibesti mountains in the north with the desert area extending from Sudan on the east, bordering Libya, to Niger on the west. The desert merges into the Sahel, pastureland on the south. With an average rainfall of 2 inches (5 cm) a year it is the driest part of the Sahara. The only vegetation is an occasional grove of palms. *(Chad – Wikipedia)*

**NIGER:** 489,000 sq. miles (1,267,000 sq km); Arid, 88%. Pasture 7%  
Sahara: The Sahara covers about 80% of the country with the Aif mountains in the center. The Sahara extends from Chad and north border with Libya, and Algeria to the border of Mali. The extent of the desert makes Niger one of the hottest countries in the world. *(Niger - Wikipedia)*

**MALI:** 478,000 sq. miles (1,238,000sq km). Arid, 60%/ pasture, 25%  
Sahara: The Sahara includes an extension of the Altai mountains. The desert's border in Mali include Algeria on the northeast, Niger on the east, and Mauritania on the west. The Sahara merges into the Sahel on the south with pastureland.

**MAURITANIA:** 396,000 sq. mi. (1,025,000 sq km); Arid, 56%; pasture, 38%.  
Sahara Desert: The desert is in the north, gradually merging into a savannah with grazing land. It is a vast sand plateau with dunes fixed by coarse grass. The desert in Mauritania is bounded by Mali on the east and south, Algeria on the northeast and Western Sahara on the northwest. The desert extends nearly to the Atlantic Ocean The desert is sandy with rugged terrain in the northeast. The desert is advancing to the south. *(Mauritania – Wikipedia)*

### **HISTORY:**

The Sahara has fluctuated in size. During the Ice Age the desert extended beyond its present boundaries. During the melting of the Ice sheets in 8,000B.C. to 6,000 B.C., there was more rainfall and much of the Sahara was Savannah. Many areas had agriculture and herds of cattle and sheep. There are many abandoned cities in the desert. Drought and overgrazing by farmers are causing desertification and the Sahara is expanding to the South. Satellite technology reveals that the Nile River once crossed the Sahara and emptied into the Atlantic ocean. Basin

*Sahara Desert was once Lush and Populated Live Science)*

**DEPRERSSION, QATTAR** The Qatari Depression is a desert basin in the Libyan Desert of northwest Egypt. The depression, at -435 feet (-133M.) is the second lowest

area in Africa. The depression covers about 7,000 square miles (18,000 sq km.) and its maximum dimension is 110 x 75 miles (180 x 120 km.). There are steep escarpments around most of the depression.

Rainfall is about 9.98 inches (90 mm.). The climate is very hot and dry.

In the depression there are saline marshes, dry lakebeds (playas) that fill with the occasional rain. In the depression is a 2 sq mile (4 sq km) Brackish lake areas of scrub and acacia trees, and several oases that are used by herders of sheep. Playas are composed of a hard crust over sticky mud. During World War II, the area proved impassable for vehicles.

The depression is an important habitat for the cheetah and the gazelles.,

A proposal hydroelectric project would pipe water from the Mediterranean Sea to make use of the difference in altitude to generate power. The water in the basin would be maintained at the 295 foot (90 m.) level, giving a drop of about 600 feet (180 m.)

Bahariya Oasis, Egypt

Farafara Oasis, Egypt

Gabaroun Oasis, Libya

Gharda Oasis, Algeria

Kufra Desert, Libya

Ouaroa Desert, Algeria

Siwa Oasis, Egypt

Timimoun Oasis, Algeria

Tozeur Oasis, Tunisia

Tuar, Algeria

### **SOUTH IRAN NUBO-SINDIAN DESERT (135,000 sq. miles (351,500 sq. km.))**

Location: southern Iran, eastern Iraq, and western Pakistan.

“The desert areas of southern Iran extend from the edge of mangrove and coastal habitat, along the Arabian Gulf in the south, to the northwest through the salt plains and Iranian Desert to the mountains that rise from it. The plant cover is similar to the North American Desert with desert shrubs and thin grassy areas. There are patches of forest. “  
(*Terrestrial Ecologies- South Iran: [wwf.worldwildlife.org](http://wwf.worldwildlife.org)*)

### **TAKLANAKAN DESERT (200,000 sq. miles) (518,000 sq km)**

The desert, located in Sinkiang Province of Western China, is landlocked, and far from any mountain snows. The desert merges with great semi-arid regions to the northwest and north to Mongolia, where lies the Gobi, a high and barren grassland steppe..

The Taklanakan Desert lies entirely in the *Tarin Basin*.

The great basins are described below after the oases.

## **TAKIAMAKAN**

**104,000 sq miles (270,000 sq km)**

Western China in the Tarin Basin.

It is the world's largest sandy desert. There is no water on the desert. Several Oases along the edge furnished stops on the Great Silk Road. The Great Silk Road branched to north and south of the desert. On the north edge were the Kuqa and Turfa. To the South were Kasha, Marin, Niya, Yarkand and Khotam.

(See Oasis) (*Taklamakan Desert – Wikipedia*)

## **THAR THE GREAT INDIAN DESERT**

Southwest India and Southern Pakistan

WWW defines the size at 92,200 sq miles (238,700 sq km)

Wikipedia defines the size at 170,000 sq miles (440,000 sq km)

Wikipedia list of great deserts: 77,000 sq miles (200,000 sq km)

The desert is about 500 miles (850 km) long and about 300 miles (485 km) wide.

The boundaries of the Thar are the Aravalli Range to the east, by the Sutiaj River to the northwest, by salt marshes (Ramm of Kutch) to the south, and by the Indus River to the west. The desert is mostly in southwestern India and partly in south Pakistan.

The Thar Desert is the result of a shift in the pattern of the monsoon winds. The Ghaggar River once flowed through the land that is the present desert. The riverbed is usually dry.

The land slopes imperceptibly to the Indus River on the west. The land is mostly covered by sand. Many areas have sand in waves up to dune waves up to 50 feet (15 m) high. In the South some individual dune may rise to 500 feet (152 m). In the heart of the sand is the bare, dune free country. Dunes tend to move with the prevailing winds. Many desert-tolerant trees and grasses are being planted to stabilize the dunes. Much of the dune-free land is sandy and sandy loam. Low areas have a high salinity. People on the desert are mostly nomadic herders of sheep and goats. Over-grazing is a common problem. Farming is relatively unsuccessful because of frequent droughts. Average rainfall is less than 10 inches (40cms). (*Thar Desert – Wikipedia*)

The **Cholistan Desert** is the name given by the Pakistanis and is part of the desert in Pakistan and covers an area of 6,200 sq miles (16,000 sq km) (*Cholistan Desert – Wikipedia*)

## **THIA DESERT (230,000 sq. miles) (595,0000 sq km)**

The Thia desert of western India and Pakistan is also known as the Great Indian Desert. It lies to the east of the Indus River. The moisture-laden air of the summer monsoon passes to the east without dropping any rain on the Thia. The Indus River valley was the home of a thriving civilization 4 to 5 thousand years ago. Since that time, the monsoon winds have shifted, leaving the area arid. (*Thia Desert – Wikipedia*)

## **TURKESTAN DESERT (750,000 sq. miles) (194 sq km)**

The Turkestan Desert is a roughly circular area with the Aral Sea near the middle. It is located in what was once southwestern Russia and borders on the Caspian Sea. Agriculture is precarious in the area, much of which is irrigation. Water has been utilized to the point that the Aral Sea is drying up.

*Western Turkestan* lies between the Caspian Sea and the Tian Shan Range. Kazakhstan, Kyrgyz Stan, Tajikistan, Turkmenistan, and Uzbekistan occupy much of the Desert. It is flat and sandy in the north and west and rises to mountains in the southeast. Crops of wheat, rice and cotton are among irrigated crops.

*Chinese Turkestan* extends from Western Turkestan to the Gobi and Tibet. The Tian Shan range is to the north and the Kunlun Mountains, rising to 20,000 feet (6,100 m), are to the south.

*Afghan Turkestan* is bounded on the north by the Oxus River.

At one time the Caspian Sea was almost dried up, about 6,000 years ago . It was dried up when the Near East during a centuries-long drought in Eastern Europe. The Caspian filled again in a wet period during the first and second millennium before Christ.

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(a) "The Desert" A Shaker Leopold, Time Life Books, New York, NY. 1962, 191 pages.

(b) "Gobi", Worldbook, Vol. 8, p. 242



## DESERT OASES

**OASES:** The Sahara has many oases below sea level. Pressure from below forces water to the surface. Oases vary from less than a square mile to Bahariya, which has many villages and a museum and is connected by highway to Cairo 185 miles (300km.).

### OASES

“In general an oasis is an isolated area of vegetation in a desert, typically surrounding a spring of similar source of similar water source.” (*Oasis – Wikipedia*)

Oases come in all sizes and shapes from the Qatara Depression to small ponds with a few palm trees. Below is a list of well-known oases. The Qatara Depression, because of its unique characteristics, has been included with a section on the Sahara Desert.

“In geography an oasis is an isolated area of vegetation in a desert, typically surrounding a spring or a similar water. Some Oases also provide habitat for animals, and, if the area is large enough, humans. The location of oases has been of critical importance for trade and transportation in deserts.” (*Oases” Wikipedia*)

The primary source for the list below has been “Oasis” by Wikipedia.

AL –HASA:	Saudi Arabia	Arabian Desert
AL-QALF:	Saudi Arabia	Arabian Desert
BAHARIYA OASIS:	Egypt	Sahara
EIN GEDI:	Israel	West of the Dead Sea
EL TOUR	Sinai Peninsula	
FARAFRA:	Egypt	Sahara
FARAFRA OASIS:	Egypt	
GABEROUN:	Libya	Sahara
GHARDA:	Algeria	Libya
HUACACHINA:	Peru	Atacama-Peruvian Desert
KUFRA:	Libya	Sahara
LOULA:	China	Lop Desert
MIRAN:	China	Taklanakan Desert
NYA (TARIM BASIN):	China	Takiamakan Desert (Tarin Basin)
OUARGA:	Algeria	Sahara
QATTARA DEP.:	Egypt	Sahara
QATIF:	Saudi Arabia	Arabian Desert
SAN PEDRO DE ATACAMA::	Chile	Mountain area
SIWA OASIS::	Egypt	Sahara
TABAS:	Iran	Iranian desert
TIMIMOUN:	Algeria	Sahara
TOZEUR:	Tunisia	Sahara
TUAR:	Algeria	Sahara
TURFAN:	China	Turfan Basin
YARCAUD:	China	Taklmakan Desert (Tarim Basin)

**AL HASA:** Saudi Arabia                      Arabian Desert, eastern area

It is the largest oasis in the world and is located about 35 miles (60 km.) from the Persian Gulf.

It has an abundance of fresh water from fresh-water springs that have emerged at oases in an otherwise dry desert. It was believed that the water flowed under the desert from the Tigris-Euphrates river system. (*“Al-Hasa” Wikipedia*)

**BAHARIYA OASIS:** Egypt                      Sahara    770 sq miles (2,000 sq km.)

It lies in a depression below sea level, surrounded by hills of black hills of quartz and dolomite. A unverified report gives it as one of the lowest spots in Africa. There are springs, both of hot and cold water.

It is approximately 190 miles (300 km.) southwest of Cairo. It is a technologically advanced oasis in the country. The main agricultural products are dates, guava, mangoes and olives. The people are mainly of the Wahati tribe and are mainly Islamic. The oasis is connected to Cairo by an asphalt road. There are electricity, television and cars.

There are approximately 10,000 mostly well preserved mummies of all walks of life. (*Bahariya - Wikipedia*)

An excellent combination of pictures and text on Egyptian history as found in the oasis. (*Bahariya – Valley of the Golden Mummies: www. Crystalinks*)

**EIN GEDI:** Israel    West of the Dead Sea in the Judean Desert and 660 feet (200 m.) above sea level. It is near Masada and caves of Qumran. The Oasis covers 6,250 acres (25 sq. km).

It is known for its springs and rich flora and fauna. A National Park has been established on the eastern border of the oasis (*Ein Gedi – Wikipedia*)

**Farafra oasis:** Egypt                      Sahara Desert (Libyan Desert) in western Egypt halfway between Dakhala and Bahariya. Its single village has about 5,000 inhabitants of Bedouin ancestry. It is the smallest oasis located in Western Egypt. (*“Farafra, Egypt” Wikipedia*)

**GABEROUN DESERT:** Libya    Sahara, about halfway between the Mediterranean Sea and the south Libyan border.

The oasis contains a large salty lake and a tourist station as well as an abandoned settlement. (*“Gabaroun Oasis” www.Wikipedia*)

**GHARDAIA OASIS:** Algeria                      Sahara Desert

The capital city of Tayerdayt had a population of 510,000 in 1998. . It is the traditional heart of the Maze Valley. (*“Gharda” Wikipedia*)

Use of underground water created a water crisis in Khopala village that was resolved by community action and the installation of drip irrigation similar to that used in Israel. This system is being developed in additional areas. *Internet: Catchwater Newsletter, August, 2000.*)

**HUACACHINA OASIS:** Peru It is in the Atacama [ Peruvian Desert in the Ica region. It is a small lake in the desert and a village with a population of 115 (1999).

The lake is a tourist attraction for residents of the nearby city of Ica and for tourists who surfboard on sand dunes in the area. (*"huacachina" Wikipedia*)

**KUFRA OASIS:** Libya It is located in the central Sahara in Southeastern Libya, surrounded on three sides by depressions, especially the Qatara Depression. In World War II, it was a communication center for flights between Libya and the Italian forces in Ethiopia, Eritrea, and Italian Somalia. British and Free French forces conducted an extended campaign to capture the fort and cut communications (*"Kufra" Wikipedia*)

**LOULAN OASIS:** China Lop Desert, in the Northeast edge of Xinjiang Province.

The site was an ancient settlement. A change in the course of the Tarim River caused the abandonment of the city as the lake "Lop Noir" dried up. The lake is now a lake of sand, having been claimed by the desert. The city was established about 200 B.C. and was a thriving commercial and administrative center on the Great Silk Road until about 800 A.D. (*Loulan - Wikipedia*)

**MIRAN OASIS:** China Taklanakan Desert, on the south rim

Two thousand years ago, a river flowed through the area and a sophisticated irrigation system was built. The area is now a sparsely settled spot. It was a thriving community on the southern route of the Great Silk Road where the Lop Noir meets the Altun Shanb Mountains (*Iran (China) - Wikipedia*)

**NIYA (TARIM):** China Taklanakan Desert on the southern edge of the Tarim Basin.

It is an archaeological site from the days of the Great Silk Road (*"Niya" www.Wikipedia*)

**OUARGLA OASIS:** Algeria Northern Algeria. Sahara.

It is a well-watered oasis with over 500,000 producing date palm trees surrounding the lake. It is a center for a flourishing oil industry as well as one of Algeria's Universities. Population was 129,400 in 1998. (*Ouakla - Wikipedia*)

**QATIF OASIS:** Saudi Arabia Arabian Desert Along the Persian Gulf.

It is a large oasis with rich agriculture and the largest (arguably) oil facilities in the world. The population is mostly Shiite Muslim in a country ruled by Sunnis.. The city of Qatif has 500,000 population (2006).

Humidity is typically very high with high temperatures but very little rain. (*"Qatif", Wikipedia*)

**SAN PEDRO DE Atacama:** Chile Atacama-Peruvian Desert.

It is a village and an Oasis around a lake in the Atacama Desert. Elevation is 7,900 feet (2,400 m.) It is an archeological site as well as a tourist attraction. Waters in the lake contain 60 times the recommended maximum of the toxic metal. Local residents

seem to have no apparent symptoms of arsenic poisoning because of long-term exposure that has rendered them immune. (*San Pedro de Atacama* Wikipedia)

**SIWA OASIS:** Egypt Sahara-Libyan Desert, between the Qatara Depression and the Egyptian Sand Sea. It is about 32 miles (50 km.) from the Libyan border and 345 miles (550 km.) from Cairo. It is an isolated oasis. It is about 50 miles (80 km.) long and 12 miles (20 km.) wide. In the center of the basin is a clear salt water lake. Excessive flow from wells used for irrigation has necessitated pumping water from the lake to the desert. Agriculture is the main economy. The population is about 23,000, mostly Berber with their own distinct language. (*Siwa Oasis – Wikipedia*)

**TABAS OASIS:** Iran Iranian Desert, , Yazd Province.  
An ancient oasis & town, located between Iran's vast salt desert and the more forbidding Dash-I-Lut desert to the south, had a population of 17,000 in the town of Tabas.

An earthquake in 1976 and measuring 7.5, Richter, killed about 25,000.  
(*the Town that Disappeared,*) *Time Magazine*.

**TIMIMOUN OASIS:** Algeria Sahara, in Gourara Province.  
It is located at the edge of the plate of Tadmait above the Sebkhah.  
It is both a town and an oasis. There is an airport.  
(*Timimoun* Wikipedia).

**TOZEUR OASIS:** Tunisia Sahara in central Tunisia.  
It is a large oasis with hundreds of thousand palm trees. It was a Roman outpost and also vital to the caravans that traversed the Sahara. The export of dates has been a significant part of the local economy. Annual precipitation is 7.3 inches (18.3 cm.). Two projects, by the government have had unfortunate results. Installing wells to tap the deep aquifers and installation of concrete pipes has caused the farmers considerable expense and by closing the traditional canals has seriously affected local animals and fish. The second project, the establishment of local oases, proved to be a failure.  
The sale of local phosphate mines, led to the laying off of thousands of workers, creating economic hardship. (*Tozeur Oasis - Wikipedia*)

**TUAT:** Algeria Sahara  
It is An area of 19,000 sq mi. (48,000 sq. km.) It is a region dotted with fertile oases rather than a single spot. Runoff from the Atlas mountains has brought much fertile alluvial soil to the region. The people are known by caste (social level) and many have slaves. Government is by local councils of local men.

Traditional oil wells are now augmented by oil exploration.  
(*Tuat - Wikipedia*)

The history of indigenous tribes was changed with the advent of Islam. In the 15<sup>th</sup> century, local authorities ordered the execution of all Jews who had fled Spain in 1492. Thousands were killed. (*Internet: retrieved from 1911 Encyclopedia org/Tuat*)

**TURFAN:** China, Xinjiang Province It is located in a mountain basin on a mountainside above the Turfan Depression. At an elevation of 98 feet (30 m.) It is in the central part of the province about 95 miles (150 km) south of the capital, Uningi. The climate is harsh with daytime averages in the summer of 100 F. (39 C.) and in January, highs average of 26 F. (-04 C.)

Heat and dryness of the summers, combined with the ancient system of irrigation produces great quantities of high quality fruit. (*Turfan-Wikipedia*)

**UQAIR OASIS:** It is located in Saudi Arabia, on the shore of the east coast of the Persian Gulf and about 50 miles north of the fertile oasis of Al-Hasa, on a recently built coastal road. The area was the site of an ancient fort and wealthy trading center prior to modern times. It is believed to have been “Gertha” of Greek and Roman times. It was the site of abundant fresh water. A fort of Islamic (?) origin stands on a lagoon. The fort was the site of a conference in 1922 that set boundaries of the various states that surround the Arabian Desert. The site sits directly across the Gulf from the Island of Bahrain.

(*Uqair- Wikipedia*)

**YARKANB:** China located on the south rim of the Takiamakan Desert

The altitude is about 3,900 feet (1,188 m.) This fertile oasis is fed by the Yarkab River, which flows north from the Kunlun Mountains. The oasis covers 1,240 sq. mi. (3,20 sq. km.) The oasis was considerably larger until desertification, which began about the 3<sup>rd</sup> century of the current era. Population is about 375,000. (*Yarkanb – Wikipedia*)

## BASINS (INTERIOR BASINS)

A number of areas in the world are interior areas and all moisture (precipitation) will drain into and collect in a low area. For the sake of brevity, only the largest will be dealt with in detail:

**CHADEAN BASIN:** A large basin in central Africa containing the river basins of the Chari and Logone river systems. The basin is surrounded by mountains. The low area is a large swampy area and Lake Chad, a lake of about 7,000 sq miles. The lake covered about 130,000 sq miles about 7,000 years ago. *Chad - Wikipedia*

**CENTRAL PERSIAN DESERT BASIN** It is a large area in Iran and a corner of Afghanistan that is an inland plateau. For further description see *Iranian Desert*)  
*Terrestrial Ecoregions – Central Persian Desert Region – WWF*

**DEATH VALLEY** It is located southeast of the Sierra Nevada Range in the Great Basin. At –282 feet (-86 m), it is the lowest spot in North America. It lies at the southern end of a trough known as the Walker Lane. Mean daily maximum temperature in January is 64 F. (18 C); July 111 F. (46 C.). Average annual rainfall is slightly over 2 inches.

The soil does not readily soak up water so floods are not unusual. The valley was inundated by a lake in prehistoric times.

A tribe of the Timbisha Indians has lived at Furnace Creek for over a thousand years.

It is in the Death Valley National Park. (*Wikipedia – Death Valley*)

**GREAT BASIN:** United States; It covers most of Nevada, over half of Utah, as well as parts of Oregon, Idaho, California, and Wyoming. It is defined as an area with no watershed outside of the basin and covers about 200,000 sq. miles (525,000 sq. km.) and is made up of about 24 smaller basins.

It is bounded by the Sierra Nevada on the west, and Rocky Mountains on the east, The basin is rugged with a number of isolated mountain ranges in the basin. The Great Basin is made up of a large number of smaller basins within its confines. Among them are the Bonneville Basin, Death Valley, and the Humboldt Sink; a total of at least 18 separate watersheds including the Humboldt River, the Truckee River, the Sevier River and the Walker River. (*Walker River – Wikipedia*)

Among lakes within the basin are the Walker Lake, Pyramid Lake (remnant of Lake Lahontan), The Great Salt lake (remnant of Lake Bonneville), Lake Tahoe and Lake Sevier

With the exception of the Death Valley Basin, the Great Basin is at an altitude of 3,000 to 6,000 feet (900 to 1,800 m) and is therefore a cold climate desert.

The Great Basin is in an earthquake area. The portion of the tectonic plate beneath the Great Basin is relatively thin and getting thinner. It is believed by many geologists that much of the Great Basin will become an inland sea, connected to the Pacific through the Gulf of California.

A number of large cities are on the fringe of the Great Basin. Among them are Salt Lake City, Utah, Carson City, Reno, and Elko, Nevada, and the Victorville area of California. (*Great Basin – Wikipedia*)

**IMPERIAL VALLEY** The Imperial Valley is located along the California border with Mexico and between the Salton Sea to the west and the Colorado River to the east. The valley was once part of the Gulf of California but silts deposited by the river cut it off from the Gulf. Much of the Valley, including the lake area, is below sea level. The American Canal brings water 80 miles (125 km) to about 50 thousand acres (200 sq km) of irrigated land. The climate allows two full growing seasons. The valley is desert and there are areas of sand dunes similar to Iraq.

*Imperial Valley – Wikipedia.*

*See also: “Salton Sea” under LAKES.*

**TARIM BASIN:** The Tarim Basin is one of the largest of the interior basins, covering 159,000 sq miles (400,000 sq. km.). It is located in the far west of China. Its northern boundary is the Tian Shan Mountain Range and in the south by the Kunlun Mountains on the northern edge of the Tibetan Plateau. The basin is within the Taklanakan Desert which covers 200,000 sq. miles. (5128,000 sq. km.). The area is sparsely populated. The major river empties into the Lop Nor, a marshy saline depression. The area of the Lop Nor was the site of nuclear testing.

A number of oases are on the northern and southern edge of the basin. They played an important role in the Great Silk Road, a series of routes that flowed on either side of the Desert. (*Tarim Basin – Wikipedia*)

Oases along the northern route. Aksu, Konla, Turfan, Gaochang, and Loulan.

Oases along the southern route: Yarkan, Niya, Pishan, Marin, and Klotan.

**TURFAN DEPRESSION: (Turfan Basin)** is a fault bounded trough in the eastern part of the Tian Shan mountains around and south of the oasis city of Turfan (*see Turfan Oasis*) located in far western China about 95 miles (150 km) southeast of the provincial capital Urumqi of Xinjiang province. It covers about 19,400 sq mi (50,000 sq km). A small lake in the middle of the depression has an elevation of -500 feet (-155 m), the second lowest land in the world. The area has about 1 inch (2 cm) of rainfall a year. There is very little natural vegetation. Temperatures range from below freezing in January to an average of over 100 F (40 C). (*Turfan Depression – Wikipedia*)

**WYOMING BASIN:** Area: 56,080 sq. miles (145,529 sq. km.)

It is mainly in central Wyoming but extends into Montana and small parts of northeast Colorado and northeast Utah. (*Wyoming Basin, physiograph Area – Internet*)

## LAKES

**ARAL SEA** (Sea of Islands) (Aral Sea Basin: Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Afghanistan) (salt) 26,523 sq. miles(68,900 sq. km.); depth, 177 ft. ((54 m.); L/W 220 x 115 miles (354 x `185 km.). River sources were the Amur Darya and Syr Darya, both of which have been diverted for irrigation purposes.,

Excessive irrigation uses all the water that formerly flowed into L. Aral. It has shrunk by 40% and has become too salty to support life. All commercial activity is gone and the shores are sandy poisonous desert. (a)

The Lake has lost 80% of its volume and 50k% of its surface area. The lake has separated into two parts, the North Aral and the South Aral. The South Aral is now a dry lake bed. Uzbekistan has built a concrete wall and diverted some of the water from the Syr River and the lake now has commercial fish.

(“Aral Sea”, *www.Wikipedia*)

**ALBERT, LAKE:** (between Uganda & Zaire)

Area, 1,640 sq. miles; (4,247 sq. km.); L/W 100 x 20 miles (193 x 32 km.) Lake Edward flows into Lake Albert through Senliki R. L. Victoria flows over Murchison Falls into L. Albert. L. Albert drains and forms the source of the White Nile River. (a) (*Lake Albert – Wikipedia*)

**ASAL, LAKE:** (Africa, Central Djibouti) extinct crater. In the southern end of the Afai Depression.

Dimensions: 6 x 4 miles (10 x 7 km.) The average depth is 24 feet (7.4 m.) The elevation is 502 ft. (153 m.) below sea level, the lowest point in Africa. The water is saline with 34.55% salt, the saltiest body of water in the world.

The source of the water is from the Indian Ocean (Red Sea). *Lake Asal – Wikipedia*)

**ATHABASCA , LAKE:** Canada (Saskatchewan & Alberta)

3,050 sq. miles.;(7,900 sq. km) Length & width 175 x 31 miles(285 x 50 km.) and a maximum depth of 380 feet(124 km.).(*Lake Athabasca - Wikip3dia*)

Its source is the Athabasca River & it discharges into the Slave R. (a)

**BAIKAL, LAKE,** (Southeast Siberia near the Mongolia border.)

12,162 sq. miles (31,390 sq. km); elevation, 1,493 feet (456 m.); depth, 5,126 feet (1,584 m.). dimensions, 395 x 49 miles 123 x 15 m.). It contains 20% of the world’s unfrozen fresh water. 23 rivers flow into the lake and the Angara flows out. The lake is the source of hydroelectric power. One end of the lake is subject to industrial pollution. It was formed by a movement of the earth’s crust about 25 million years ago. The nearest city is Kusk. (a)



**BALKHASH, LAKE:** (inland) (Kazakhstan)

Area, 6,670 sq. miles 17,275 sq. km); elevation, 1,122 ft. (342 m.) The lake is 370 miles (600 km.) long and from 3 to 45 miles (5 to 70 km.) wide. The lake is like a very narrow piece of intestine with the wide part on the Western end and the rest flows East. A sandbank separates the two parts with the eastern area being saline and the west, fresh water. Since 1972, the lake is gradually drying up. The Ill river supplies 80% of its water. The population, both in Western China and in Kazakhstan has increased and agriculture and industry are utilizing most of the water. The problem has been compounded by pollution and the presence of metals in the soil. The lake separates a semi-arid land to the north from a desert to the south.

Major inlet is Ill R. There is no outlet. A number of other rivers enter the lake.  
(a) )*Lake Balkhash – Wikipedia*

**BONNEVILLE, LAKE** (Inland, extinct) Utah, USA

Great Salt Lake is the remnant of Lake Bonneville. Lake Bonneville existed from 100,000 to 50,000 years ago. A change in climate gradually reduced it to its present size. There are about 50 lake shore terraces at different levels, each established the level of the lake for a considerable period of time. At its highest, Lake Bonneville was about 1,050 feet deep and covered about 19,750 square miles, larger than Lake Erie. It was about 346 miles long and 145 miles (550 x 235 sq km) wide. The elevation of its surface was about 5,200 feet (1,600 m) above sea level. At its highest, it broke over the rim of the Great Basin at Rock Pass Northwest of Preston, Idaho, thence to the Snake River and finally into the Pacific ocean. Over a period of time it cut a canyon until it reached bedrock and stabilized at about 330 feet (100 m) below its highest level. A change of climate reduced the flow of water into the lake and it gradually was reduced by evaporation to its present level as the Great Salt lake. ©

**CASPIAN SEAL** (inland) Russia, Kazakhstan, Turkmenistan, Iran, Azerbaijan

(saline) The area is 151,828 sq. miles (391,767 sq. km.); elevation (-92) ft. (30 m); depth, 3,363 ft. (1,029 m.); It is larger than the state of Montana.

Major rivers that drain into it are Volga, Ural, Emba, Terek, & Kut. Irrigation has in the Caspian Basin has reduced the flow into the Caspian substantially and it is shrinking. The Caspian is less salty than the ocean and abounds with fish. The Caspian may be in trouble in the future as more of its inflow is utilized in irrigation. *Caspian Sea – Wikipedia*)

**CHAD, LAKE:** (inland) Chad, Nigeria

Area, 6,800 sq. miles (17,600 sq. km.); depth, up to 22 ft. (7 m.) The lake has shrunk from 8,000 sq miles (20,700 sq. km.) because of long-term drought. Much of the lake is covered by a tangle of grasses. Average depth is about 4 ft. (a) The lake lies in a basin, fed by the Chari and Logone rivers. About 7,000 years ago the lake covered 130,000 sq. miles (330,000 sq km.) (*Chad - Wikipedia*)

*Chari River* provide 905% of the water flowing into the lake. It flows from the Central African Republic along the border of Cameroon into Chad.

Over 20 million people of 4 countries, Chad, Cameroon, Niger, and Nigeria, depend on the water of Chad lake.. Water percolates from L. Chad into Soro & Bodele Depressions. The lake has a number of islands and mudflats.

**CHAMPLAIN** (Canada, USA, between New York and Vermont,)

It is a long narrow lake in the Appalachian valley. L, W. 110 x 12 miles (180 x 19 km), maxes. Depth is 400 feet (122 m). The lake covers 440 sq mi (1,130 sq km). The lake is. Surface elevation is 95 feet (29 m). Lake Champlain drains into the St. Lawrence River and is connected to U.S. waterways by L. George and the Erie Canal.

It is of significant historical importance. During the Revolutionary war, an American fleet was defeated by the British but delayed a British army under Burgoyne by a season, leading to their defeat. A similar battle in 1813 was won by the U.S. voiding English claims of American soil. The lake is a tourist attraction. *Lake Champlain – Wikipedia, the free encyclopedia*

**COMO, LAKE** (Lombardy, northern Italy. See Italy)

Length 38 miles (46 km.); width 3 miles (4 km.) The primary river is the Adda River. Total surface area is 54 sq. miles (140 sq. km.)

It was reported in 2007 that L. Como is too polluted for swimming.

*Lake Como – Wikipedia)*

It is an area of great beauty. (a)

**CRATER LAKE:** California U.S. Lake is in crater of Mt. Mazama.

20 sq. miles (50 sq. km.), elevation 6,200 ft. (1,900 m.)

Its depth is 1,932 feet (589 m.) and is the second deepest lake in North America. There are no known outlets and no streams except runoff from edge of crater. The area is a National Park. (See Mount Mazama) *(Crater Lake – Wikipedia)*

**DEAD SEA** Jordan, Israel

The length is 42 miles (63 km); Width is 11 miles (18 km.) (salt) 400 sq miles; elevation (-1,310) feet; (-400 m) depth, 1,310 feet (400m).

Its only source is the Jordan River. It is located in the Dead Sea Rift, an extension of the Great Rift Valley. The Great Rift Valley extends from the Taurus Mountains in Turkey to the Zambezi Valley in Southern Africa.

The Dead has too much salinity to support life and the reduced flow of the Jordan River because of irrigation and dry years is increasing the salinity and lowering the water level. *(Dead Sea – Wikipedia)*

**EDWARD, LAKE:** In the Great Rift Valley between Uganda & Zaire.

Area, 856 sq. miles (2,217 sq. km.); L/W 40 x 32 miles (4 x 38 km.). It is the source of the White Nile with the flow of water from L. Edward by the Ruwenzori R. into L. Albert. *(Lake Edward – Wikipedia)*

**ERIE, LAKE**

United States, Canada

Area, 9,940 sq miles (25,745 sq. km.); elevation, 569 ft. (172 m.); greatest depth, 210 ft. (64 m.); L/W 241 x 57 miles (340 x 92 km.).

It is the shallowest of the Great Lakes with average depth of 62 ft. (19 m) Water flows from L. Huron through L. Erie to the Niagara R. and on to L. Ontario. Ships travel the Welland Canal between L. Erie & L. Ontario with a lift of 320 ft. (97 m) (a)

Lake Erie was highly polluted in the 1960's but diligent practices in pollution control, especially by Toledo and Cleveland, have made the lake safe for recreational and commercial activities.

**EYRE (inland)** Southwest Australia

3,780 sq. miles (9,790 sq. km.); L/W 90 x 40 miles )145 x  
It is a dry salt flat except after heavy rains. (a)

**GENEVA, LAKE:** W. Switzerland

Area, 225 sq. miles (582 sq. km.); L/W 45 x 9 miles (73 x 14 km)  
It is a very popular vacation area with varied sports. (*Lake Geneva – Wikipedia*)  
It is formed by a natural dam on the Rhone R. (a)

**GREAT BEAR LAKE** Central Canada

12,000 sq. miles (31,000 sq. km.): depth, 1,299 ft. (395 m.); L/W 211 x 177 miles (642 x 285 km.). The maximum depth is 1,463 feet (446 m) (a)

It is the third largest lake in North America. The lake straddles the Arctic Circle. The Great Bear Lake empties into the Mackenzie River system through the Great Bear R. *Wikipedia – Great Bear lake*

**GREAT SALT LAKE:** Utah, United States

Area: 1,500 square miles 3,870 sq. km.). Elevation, 4,110 feet (1,250 m.).  
Depth. 44 feet (14 m.). It is about 70 miles (110 km) long and about 50 miles (80 km.) wide. It is an inland lake, once part of a freshwater lake called Lake Bonneville, which was located in the eastern part of the Great Basin. Its salinity is about 25%, total saturation. It contains about 6 billion tons of salt. ©

An unusually heavy snowfall brought flooding to Utah, raising the level of the Lake to the outskirts of Salt lake City. Great pumps were used to pump the water to flats to the West. Some streets were small rivers.

**GREAT SLAVE LAKE:** northern Canada

11,170 sq. miles (30,200 sq. km.); depth, 2,110 feet. (650 m.). Elevation 512 feet. (155 m.)/ Its chief sources include the Athabasca, Slave, and Peace Rivers. Its outlet is the beginning of the Mackenzie River system. *Great Slave Lake – Wikipedia*)

**HURON, LAKE** United States, Canada

23,010 sq. miles (61,150 sq. km.); elevation, 577 ft. (177 m.); depth, 710 ft. (217 m.); L/W 206 x 183 miles (320 x 293 km.).

It receives water from L. Superior by the St. Mary R. Water flows from L. Huron to L. Erie by way of St. Clair & Detroit Rivers. (a)

It is an important lake for commercial fishing and as an inland waterway.

**KIVU**

1,400 sq mi. (2,700 sq km) 59 x 30 mi. Maximum depth is 1,575 feet (480 m.) Its volume is about 120 cubic miles. The lake is located in the W. branch of the Great Rift Valley between Uganda and the Democratic Republic of Congo. Its waters empty into L. Tanganyika. The water also contains about 15 cubic miles of methane and 60 cubic miles of carbon dioxide, making it one of only 3 lakes worldwide that can literally explode. The lake is surrounded by about 2 million people. Such an explosion would kill hundreds of thousands of people through asphyxiation. A methane extraction process will shortly produce enough gas for a 25MW plant in Uganda, enabling that country to satisfy its needs and with surplus to sell to neighboring countries. *See also L. Nyos and L. Monoun*

**KOKO NOR, LAKE** CHINA

2,400 sq. miles; (6190 sq. km.) Prior to 1960, 108 freshwater rivers emptied into the lake. By 2003, 85% had dried up because of irrigation and land reclamation. Much of the lake is shallow and, as a result, there has been a splitting and there are now many small lakes. The lake has abundant fish but a continued drop in the lake level and increased salinity will ultimately destroy the fishing. *(Lake Koko Nor – Wikipedia)*

**LADOGA, LAKE:** Russia, 40 miles NE of St. Petersburg.

Area is 7,104 sq. miles (18,330 sq. km.) The length is 130 miles (210 km.) and its width is 84 miles (138 km). Its greatest depth is 680 feet (210 m). There are about 660 islands in the lake. The Basin has about 50,000 lakes and 3,500 rivers *(Lake Ladoga – Wikipedia)*.

It is part of a waterway through L. Onega to the White Sea from the Baltic. (a)

Lake Ladoga is only 16 feet (5 m.) above sea level. It is part of a major waterway from the Baltic to Moscow and the lower Volga. *Lake Ladoga – Wikipedia)*

**LASYK-KUL** RUSSIA

2,200 sq. miles: ( 3,520 sq. km.) (a)

**LOP NOR:** Tarim Basin in China

A fresh water lake that was on the Great Silk Route. The thriving city of Loulan was located on its shores. It is now a lake of sand. *(Loulan, Ancient City. Silk Route – Internet)*

**MANITOBA, LAKE:** Manitoba, Canada

Area, 1,750 sq. miles (4,624 sq. km.) extremely shallow; L/W 120 x 29 miles (200 x 49 km). Its maximum depth is 812 feet (248 m.) The primary inflow is the Wachen River., outflow, Dauphin River. and ultimately Hudson Bay. It drains through Dauphin R. into L. Winnipeg *(Lake Manitoba – Wikipedia)*

**MARACAIBO, LAKE:** Western Venezuela

Area, 5,217 sq. miles (13,460 sq. km.); a channel connects it with the Caribbean Sea. (a)

It is the largest lake in South America, It is directly connected with the Caribbean Sea by a channel. With a maximum depth of 157 feet (60 m.)it is used by large ships. Vast quantities of oil are drawn from the Maracaibo Basin with a resulting subsiding of the land. (*Lake Maracaibo - Wikipedia*)

**MICHIGAN, LAKE** United States Third in size of the Great Lakes..

22,400 sq. miles (57,800 sq. km.); elevation, 577 ft. (175 m.); depth, 923 ft. (289 m); L/W 300 x 118 miles (480 x 189 km.)

Its level is in common with L. Huron. Some of its water is diverted into the Mississippi through the Chicago River. There was considerable pollution from Chicago & steel mills in early years. (a)

When the lake was at its highest, much of the cliff area on the Michigan side crumbled, causing the loss of many homes.

**MOMOUN, LAKE CAMAROON**

It lies in the Okyu Volcanic Field. It one of only 3 lakes worldwide, known to have concentrations of gas (carbon dioxide) deep under its surface. An eruption of gas caused a number of deaths in 1984. . A pipe has been installed to bleed off gas from deep in the lake to reduce the danger.

**MONA LAKE: E Central California**

Salt inland lake formed from the crater of a volcano.

Mona Lake is a major stopping place for migratory fowl. It is also a nesting place. Prior to 1990 the lake level dropped 40 feet (12 m) because of diversion of its water to Los Angeles. State and Federal regulations forced the Los Angeles Water Authority to restore water to the lake and it is recovering.

**NICARAGUA, LAKE** Nicaragua, Central America 12 mi. (19km.) E of Pacific Ocean & 70 mi. (112 km.) W. of Caribbean.

Its area is 3,066 sq. miles (9,290 sq. km.); L/W 96 x 39 miles (144 x 62 km.).

It is connected by the Tipitapa R. to L. Managua..(a)

**NYASA, LAKE** Malawi and Mozambique. 400 miles(640 km.) from the Indian Ocean. Its area is 11,100 sq. miles (28,400 sq. km.); depth, 2,310 ft. (700 m.); L/W 350 x 50 miles (480 x 80 km.)

It drains into the Indian Ocean through the Shire and Zambezi R. It is the southernmost and the largest of a chain of large lakes in the Great Rift Valley. (a)

**ONEGA, LAKE** northwest Russia, , NE of L. Ladoga

7,8924 sq. miles (20,440 sq km) .

It empties into L. Ladoga through the Svir R. A canal leads eastward to the White Sea. (a)

**ONTARIO, LAKE** United States, Canada

7,540 sq. miles (19,450 sq. km.); elevation, 243 ft. (74 m.); depth, 807 ft. (242 m.); L/w 183 x 53 miles (293 x 85 km.) The lake is part of the inland Waterway.

The surface water flows at 1.3 miles per hour from the Niagara R. to the St. Lawrence R. (a)

**PONCHATRAIN, LAKE** southeast Louisiana, USA

650 sq. mi. (1630 sq. km) average depth of 12 to 14 ft (6 m). It is 2<sup>nd</sup> largest salt-water lake in U.S. It is connected to the Gulf of Mexico by a dredged canal and is outlet for several rivers. Its salinity varies. Its 40 x 24 miles (64 x 39 km).

**PYRAMID LAKE:** It is in the basin of the Truckee River in the Northwestern part of the Great Basin. L/W 30 x 9 miles (48 x 14 km); and the maximum depth is 356 feet (108 m.) The primary source of water is the Truckee River, which is the outlet for Lake Tahoe. It is an inland lake with no outlet. It is well known for a multitude of *tufas*, which are formations of calcium carbonate. These probably formed as calcium from springs in the bottom of the lake, combined with carbonate from surrounding mountains.

Pyramid Lake is the remnant of a much larger lake that covered over 8,800 sq miles (22,300 sq km.)

**QINGHAI LAKE:** China, Tibet It is located 60 miles (100 km.) west of Dining. Its area is 2,278 sq. miles (5,694 sq. km.) It is an inland lake. Because of irrigation, the lake is shrinking. Its abundance of fish will be impacted.

It is the largest lake in China. *Qinghai Lake – Wikipedia*

**REINDEER LAKE:** Canada

Its area is 2,440 sq miles (6,295 sq. Dimensions are 155 x 37 miles (250 x 60 km.); *(Reindeer Lake – Wikipedia)*

It is located between Saskatchewan and Manitoba and drains into the Churchill River system.

**RUDOLPH, LAKE:** (Lake Turkama) Kenya

3,500 sq. miles (9,030 sq. km.) (a)

It is a slightly salty inland lake. Water drains from Ethiopian highlands. It is known for plentiful fish and large Nile perch. Nile crocodile breed in the area.

**SAINT CLAIR** It is a connecting link between Lake Huron and Lake Erie and forms a part of the border between Michigan, U.S. and Ontario, Canada.

Maximum L x W are 26 x 24 mi. (42 x 39 km.) and its area is 440 sq. mi. (1,114 sq km). It is very shallow with a maximum depth of 27 feet (8.2 m.) It is a vital water-way for commerce requiring dredging.. It is a few miles up the Detroit River from Windsor and Detroit.

Recreational fishing is a major activity on the lake. *Lake St. Clair – Wikipedia, the free encyclopedia*

**SALTON SEA:** : (Imperial Valley, California, USA)

Area: about 250 square miles(645 sq. km.). It is 30 miles by about 8 to 10

miles,(48 x 15 km.) and is quite shallow. It is about 230 feet below sea level (-69 m.). The depression was once part of the Gulf or Lower California but was cut off by sediment from the Colorado River estuary. The area became a dry basin.

Between 1903 and 1905, the Colorado broke through irrigation canals and began to flow into the basin. By 1907, efforts to return the Colorado to its original bed were successful. Since then, the only source of water has been runoff from irrigation canals the lake has shrunk to its present size. Its importance as a link in bird migration and for fishing and recreation, has increased its priority for water from the Colorado.(d)

**SUPERIOR, LAKE:** United States, Canada

Its area is 31,820 sq. miles (82,100 sq. km.); elevation, 600 ft.; (180 km.); depth, 2,440 ft. (732 m.); L/W 350 x 160 miles (570 x 256 km.) It drains through St. Mary R. into L. Huron. About 200 rivers enter the lake, most from the North. Much of the shore-line is lined with cliffs and many rivers enter over waterfalls. (a)

There have been proposals that some rivers that flow into Hudson Bay should be diverted to L. Superior.

**TANA, LAKE:** northwestern Ethiopia. It is the source of the Blue Nile.

Estimated area is 1,200 sq. miles (3,100 sq. km.): elevation, 6,000 ft. (1,800 m.); L/W 47 x 44 miles (75 x 51 km.).

Its waters are silt-free, giving the Nile the name of Blue Nile. (a)

**TANGANYIKA, LAKE:** Burundi, Tanzania

Area is 12,950 sq. miles (33,411 sq. km.); elevation, 2,334 ft. (700 m.); depth, 4,708 ft. (1,412 m.); L/W 480 x 37 miles (67 x 50 km.). It is a Great Rift Valley Lake with a maximum depth of 4,820 feet (1,470 m.). (*Lake Tanganyika – Wikipedia*)

The outlet is Lukugu R. It is the longest and second deepest lake in the world. (a)

**TAUPO, LAKE:** North Island, New Zealand

Dimensions are 33 x 20 miles (46 x 33 km.); Depth is 575 feet (180 m.)

It is on the Waikato River. The lake is in the caldera of a volcano that had a major eruption in 180 A.D. current era. (see Taupo mountain) (*Lake Taupo – Wikipedia*)

**TITICACA, LAKE:** Peru, Bolivia

Area, 3,251 sq. miles (8,388 sq. km.); elevation, 12,500 ft. (3,750 m.); depth, over 900 ft. (270 m.); L/W 110 x 45 miles (176 x 72 km.)

The Desaguadero R. is the outlet. It empties into L. Poopo in Bolivia. It is the highest navigable lake in the world. (a)

Certain tribes live on the shores of L. Titicaca and live off its bounty.

**TOBA, LAKE:** Indonesia, N. Sumatra, on Indian Ocean

Area, 425 sq miles (116 sq. km.); elevation, 2,970 feet (890 m.) depths 1,737 feet (521 m.).

“Toba is the largest caldera lake in the world and is located high in the Barisan

mountains of northern Sumatra. The lake is oval in shape, 56 x 19 miles (90 x 300 km.). The cliffs rise up to 3,900 feet (1,170 m.) above the lake” (b)

An eruption about 30 thousand years ago produced the island of Sanrosir. The outlet to the lake is the Asahan River. (See Mmountain) *Toba Catastrophe Theory - Wikipedia*)

**TORRENS, LAKE:** (inland-saline) South Australia  
Area, 2,440 sq. miles (6,295 sq. km.); L/W 120 x 40 miles. (193 x 64 km.) (a)

**TURKAMA, LAKE:** (inland, slightly salty) South Ethiopia  
Area, 2,475 sq. miles (6,390 sq. km.) (a)  
Many small rivers flow from Ethiopian highlands into the lake. The lake is known for large Nile trout. (a)

**VANERA, LAKE :** Sweden  
Area, 2,150 sq. miles (5,547 sq. km.); (a)

**VICTORIA, LAKE:** Kenya, Tanzania, and Uganda (on the equator)\  
26,828 sq. miles (69,216 sq. km.); elevation, 3,723 ft. (1,117 m.); depth, 270 ft. (81 m.); L/W 260 x 150 miles (419 x 242 km.). *Lake Victoria – Wikipedia*)

It is the second largest freshwater lake in the world. It is the chief source of the White Nile (a)

**VOSTOK, LAKE:** Antarctica Russian Sector, 78.5 degrees S. Lat, 107 E. Long.  
Lake Vostok lies under 2.5 miles (4 km) of ice. The lake is about the size of L. Ontario. It measures 155 x 31 miles(265 x 50 km) Pressure of ice on the water is about 5,000 pounds (2,300 kg )per sq. in.. The total area is about 6,000 sq. mi. (15,6700 sq km).The water has about 30 times the oxygen level as fresh water at sea level. The lake has two deep basins with shallow water between. The north basin is about 1,300 feet (400 m.) deep and the south basin is about 2,700 feet (1,000 m) deep. Water is 27 degrees F. (-3 C). Water under great pressure will remain liquid down to 27 degrees F. (h)

**WINNIPEG, LAKE:** Manitoba, Canada  
Area, 9,084 sq. miles (23,440 sq. km.); L/W 258 x 60 miles (413 x 95 km.).  
Among the rivers flowing into L. Winnipeg are Saskatchewan, Red River of the North, Nelson, and Winnipeg. (a)

Both L. Manitoba and L. Winnipegosis flow into L. Winnipeg. The total drainage area into l. Winnipeg is 380,000 sq mi (984,200 sq km). The drainage area includes parts of North Dakota, Minnesota, Manitoba, Ontario, and Saskatchewan. Outflow into the Nelson River averages 1.67 acre feet per second (2,060 cubic m).

**WINNIPEGOSIS, LAKE:** Manitoba, Canada It is the second largest lake in Manitoba.  
The surface area is 2,075 sq. miles (5,370 sq. km.); Maximum depth is 834 feet (254 m.). L/W is 121 x 32 miles (155 x 51km.). It drains through L. Manitoba into the nelson



River system. The lake is specially known for commercial fishing of Walleye and other freshwater fish. (*Lake Winnipegosis Wikipedia*)

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- (a) World Book, 1987, Vol. 12, pp 32-49
- (b) *Earth*, 2003, Smithsonian, "Lakes & Rivers" p 231.
- © *The Valley of the Great Salt Lake*, reprint from Utah State Historical Quarterly, Volume XCXVII, Number 3, July, 1959; Utah State historical Society, pp. 303-304.
- (d) *world Book*, 1987, volume 17 , p 77.
- (e) *Wikipedia*, *Lake Vostok*.

## MOUNTAINS (a)

Mountains are of two basic types, those formed by land uplift, as between tectonic plates, and those formed through volcanic action. The makeup of the mountains will vary according to the history of the area before the uplift occurs. Many islands are the result of uplifts or of volcanic origin. An excellent example of this in New Zealand. The South Island is the result of uplifts as Tectonic plates collided. The North Island is of volcanic origin.

Mountain ranges are formed when one plate collides with another and one starts to slide under the other. This is a *subduction zone*. A great amount of heat is generated and the melted material rises as liquid in volcanoes. The Andes, Rockies, Cascades, and Himalayas have formed in this way. Many of the mountains in these ranges are uplift and others are volcanic. The Rockies are uplift and the Cascades are mainly volcanic in origin.

There are 5 basic classifications of mountains, depending on the process by which they are formed:

- (1) *Volcanic mountains* are mountains built up as pressure forces volcanic material to the surface and gradually builds up.
- (2) *Fold mountains* are formed when two tectonic plates collide. The Alps and the Appalachians are examples of “fold” mountains. (b),
- (3) *Faulted block mountains* form when blocks fracture and tilt. Examples are the Tetons, the Sierra Nevada and the Wasatch ©
- (4) *Domed mountains* form when pressure from below forces a portion of an plate into a dome. The Appalachians and the Black Hills are examples of “Dome” mountains.
- (5) *Erosion mountains* occur when a portion of sedimentary rock is left exposed through erosion. (b)

Mountain ranges such as the Rocky Mountains contain Volcanic, folded and block-type mountains. ©

## VOLCANOES

Volcanoes form above magma chambers in the crust of the earth. The crust is a relatively thin layer of solid earth that floats on the surface of the liquid magma, a major component of the earth. In many areas, a blister or magma chamber will form within the crust. This is often connected by a tube. Within the earth are hot spots that partially melt upper layers of rock, forming gas in the magma chamber. It becomes lighter than surrounding rock and gradually works toward the surface. In some cases the chamber may have an opening to the surface and you will have a frequent flow of lava. In others,

the passage to the top of the ground may be obstructed and pressure will build up to an explosive eruption.

Mount Kea, a volcanic mountain on the Island of Hawaii is the world's tallest mountain, rising a total of 33,470 feet from the bottom of the ocean to an elevation of 13,796 feet.

*Volcanoes are of 6 types, Shield volcanoes, strata volcanoes, rhyolite caldera complexes, Flood basalts, & mid-ocean ridges.*

*Shield Volcanoes* are the largest volcanoes that look like volcanoes. Shield volcanoes are almost exclusively basalt. Basalt flows easily when hot so volcanoes are not steep. 90% of the volcano is lava rather than pyroclastic. They are rarely explosive unless water gets into the vents. Most come from hot spots (magma chambers) but some may come from subducted plates as in the Andes. Examples are the Hawaiian volcanoes and Kilimanjaro.

*Strata Volcanoes:* Almost 60% of all volcanoes are strata volcanoes. Their eruptions are of andesite and dacite, cooler and more viscous than basalt; this allows gases to collect and build up to high levels. They are effective plugs and explosions can be quite violent. They usually form along subduction zones and there may be long dormant period between eruptions. Most strata volcanoes are subject to "Lahars" or mudflows that can cause devastation, burying villages and farms and causing the death of many people. Examples of strata volcanoes are Mt. Rainier, Mt. St. Helen, Nevado del Ruiz, Pinatubo, and Mt. Fuji.,

*Rhyolite Caldera Complexes:* These volcanoes are the most explosive on earth. They explode so violently that they form a collapsed caldera rather than building up a mountain. Magma chambers are usually very large and ash can cover thousands of square miles. Yellowstone covered up to a million square miles in its last explosion about 650,000 years ago. Many calderas are lakes or bays. Examples of Rhyolite Caldera Complexes are Yellowstone, Toba, Tambora, Taupo, La Primavera, Rabaul, and others, about 83 in all. "If the magma is rich in silica and other metallic particles it has a high viscosity and holds gases in liquid form. A reduction in pressure as the magma reaches the surface, causes the gases to explode violently. "Caldera" Wikipedia, the Free Encyclopedia

*Monogenetic Fields* Areas that contain steam vents, geysers, hot & boiling springs and/or other products created by subterranean action. Among these are Valley of the Thousand Smokes and Soda Springs

*Flood Basalts:* Some parts of the world are covered thousands of square miles of thick and individual basalt flows. It is believed that these flows were relatively slow and of long duration. The Columbia River basalt flow began in SE Washington and flowed all the way to the Pacific and into the ocean.

*Mid-ocean Ridges* The mid-ocean ridge extends around the planet for about 40,000 miles. It is formed by magma flowing as the tectonic plates are pulling apart, moved by convection in the upper mantle and lava flows upward, filling the gap. The lava is basalt.

Volcanoes have individuality; therefore each volcano is a little different. There are several types of volcanoes, according to their physical makeups.

*Composite Volcanoes* are formed when both lava and tephri build up a steep cone that builds and collapses over time. Mt. Fuji and Mount Vesuvius are excellent examples of Composite volcanoes. (b)

For the purpose of the Section on mountains, only “volcanoes” will be tagged unless articles specify which of the other types a mountain is. The front range of the Rocky Mountains is folded.

## **MOUNTAINS IN GENERAL**

Rocky Mountains run about 3,300 miles from New Mexico to Alaska. The Pacific range includes two parallel systems. The Cascades run 2,500 miles (4,000 km) from Southern California to Alaska and include the Olympic Peninsula and many islands along the coast of British Columbia. The other is contains the Sierra Nevada of California, the Cascades of Oregon, the coast mountains of British Columbia and Alaska, and the Aleutians. ©

The Andes system stretches 4,500 miles (7,250 km) on the Pacific coast of S. America. It is mainly a subduction system and has a high percentage of igneous rich from volcanic action. ©

The Tethy Mountain System stretches over 7,000 miles (11,200 km) from the Atlas Mountains of Africa, the Alps, the Carpathians, and the Caucasus the Pamirs the Caracara, and finally to the Himalayas. ©.

## THERMAL HOT SPOTS

*Hot Spots and Geysers:* are listed with volcanoes and are from the same sources as volcanoes and, in some cases may be *Mega Volcanoes (Rhyolite Caldera Complexes)* with large magma chambers that explode with such violence that no typical cone is developed. Yellowstone is an example of a super volcano. They or their manifestations are near the surface of the crust and may be especially adaptable for *geothermal power*.

### Listing of well-known thermal areas

Beppu	Japan, Kyushu Island
Bogoria	Kenya
Chaudus-Aigues	France, Central
El Taito geysers	Chili
Geysir	Iceland, 50 miles s of Reykjavik
Lardarello	Italy, Tuscany
Lipatari	Italy, island 25 n of Sicily
Nagano	Japan, Honshu, n of Tokyo
Rotorua	New Zealand, Rotorua, N. Island
Sierra la Primavera	Guadalajara, Mexico
Soda Springs	United States, Idaho
Solfatara	Italy, N shore of Naples Bay
Strokker Geysers	Iceland, 50 mi. east of Reykjavik
Valley of the Thousand Smokes	United States, Alaska
Waimangu	New Zealand near Rotorua, N. Island
Yellowstone	United States, Wyoming

## FLOOD BASALT (TRAPS)

“A Flood Basalt or Trap Basalt is a major eruption or series of eruptions on land or the ocean floor that coats it with large amounts of basalt lava. **It may come from a tectonic break such as Iceland.**” It is of low viscosity so it flows over large areas. They almost always occur along beaks in tectonic plates or between tectonic plates. The Deccan Traps covered half of India and the Siberian Traps covered over a million square miles. Some have a thickness from 200 to 12,000 m (700 to 7 miles). The earth’s crust depresses under the weight. The flows are accompanied by large amounts of gas, carbon dioxide and

*Flood Basalt – Wikipedia, the free encyclopedia*

*Columbia River Basalt Group* In Washington, Oregon & Idaho occurring from 17 – 6 million years ago. The flows covered about 63,000 sq miles with about 65,000 cubic mi of basalt.

*Coppermine River* basalts in NW Canada erupted about 120,000 cubic mi. of lava that covered over 65,000 sq. mi. It occurred about 1,267 mya.

*Siberian Traps* in Siberia between 251 & 250 mya. It covered between 2 & 3 million sq mi. Total volume of basalt was about ½ to 1 million cu mi. The eruptions were at the same time as the “Great Death” and the gasses given off by the eruptions were likely responsible for the 90+% die off of many species.

*Siberian Traps – Wikipedia, the free encyclopedia*

For a list of 19 Flood basalt incursions, see *Geological Society – Flood, Basalts, mantle plumes and mass extinctions.*

## MOUNTAIN RANGES

**Ahaggar Elborz** Africa, Southern Algeria about 900 miles (1,500 km.) south of Algiers. They are mainly of volcanic rock. The highest point is Mount Tahat at 9,840 feet (3,000 m). Rainfall is sparse and sporadic but temperatures are lower than the Sahara plateau. *Ahaggar Mountains – Wikipedia*)

**Alaska** N. America-Alaska (Brooks Range) See Rocky Mountains. “The Alaska range is a relatively narrow range, extending 400 miles (650 km) in the southern region of Alaska.” (*Alaska Mountain Range – Wikipedia*)

**ALBORZ:** northern Iran straddling the border with Armenia in the north to the Caspian Sea in the South It is 37 to 80 miles (60 to 130 km.) wide. The mountain consist of sedimentary prevalently Jurassic limestone over a granite core. *Alborz – Wikipedia*)

**Alps** Europe 600 miles, 950 km). The Alps form a broad arc through France, Italy, Germany Switzerland, Liechtenstein, & Slovenia. It is the largest mountain system in Europe. They begin in France near the Mediterranean Sea and form a broad arc across southern Europe. They are about 160 miles (260 km) at their widest. The highest peak is Mont Blanc, 15,203 feet (460 m.).

History: The Alpine area was once a seabed. Great pressure forced the area up to form the Alps. Many areas are of different types of rock. *(Alps – Wikipedia)*

**Altai** (Altay) Mountains: (Asia, Southeast border of Mongolia and extending into Russia. The mountains extend into the Gobi. They are rugged, and reach heights up to 14,350 feet (4,374 m.) (a)

**Andes** S. America. 4,500 miles (7,200 km) long and 400 miles (640 km) wide; from Cape Horn to Central America, through Chile, Peru, Colombia, & Venezuela. Many peaks are over 20,000 feet (6,100 m.) altitude. The highest is Aconcagua at 22,200 feet (6,840 m.). They are the result of y the subduction of the Mazca tectonic plate with the S. American plate. Many of the mountains are of volcanic origin and some are active. The area is in an earthquake zone.. *(Andes – Wikipedia)*

**Apennines** Europe, Italy. They are a range of mountains S. of the Poe valley, and are the spine of Italy, running the entire length of Italy South of the Poe valley. The mountains are rugged and forested. They consist mainly of soft rock that is eroding from rain and deforestation. *Apennines – Wikipedia*)

**Antarctic Pen.** Antarctica. A range of mountain on the Antarctic Peninsula, extending directly toward S. America *Antarctic Peninsula – Wikipedia*)

**Appalachian** N. America (U.S.) They run 1,500 miles (2,400 km) from Birmingham, AL. to the Gaspé Peninsula in Quebec, Canada.. Heights range up to 6,620 feet (2,012 m) on Mt. Mitchell in N.C. They were formed between 250 & 450 million years ago. They include the White Mountains, the Green Mountains and the Catskills. The system is up to 200 miles (320 km) wide and includes a number of large valleys and several gaps.

*Great Smokey Mountains* are at the southern end of the Appalachians and the peaks are the highest in the chain with Mt. Mitchell in the Great Smokey national being the tallest. (*Appalachian Mountains – Wikipedia*)

**Atlas** Africa, They are in NW Africa, extending for 1,500 miles (2,400 km), from Cape Rhir on the Atlantic to Cape Bohn on the Mediterranean. They extend through Morocco, Tunisia and Algeria. The mountains are several parallel ranges in some areas. The highest mountain is Jebel Toubkal at 13,665 feet (4,209 m.). Some areas are heavily forested, especially on plateau areas that separate some of the ranges. (*Atlas Mountains – Wikipedia*)

**Balkan Mountains:** Europe. SE Europe, in the former Yugoslavia, and the major chain of mountains in Bulgaria. The mountains are an extension of the Carpathian Mountains The range runs 300 miles (500 km.) from eastern Serbia to Cape Emine on the Black Sea. The mountains are rugged with deep valleys and were the area of resistance by Tito and the resistance against Germany in World War II. (*Balkan Mountains – Wikipedia*)

**Brazilian Highlands** S. America, South Central Brazil. The highlands are from 1,000 to 3,300 feet (300 to 900 km) elevation and extend from the Amazon tropical basin to the Atlantic in southern Brazil. Much of the Highlands drains into the Amazon. The Brazilian Highlands covers about half of Brazil or about 1,500,000 sq. Miles 3,900,000 sq km). (*Brazilian Highlands -- Wikipedia*) (b)

**Brooks Range** N. America-Alaska to a height of 9,000 feet (2,900 m) It is the Northern extension of the Rocky Mountains. Steep, rugged slopes with deep slashes from Glaciers. (*Brooks Range - Wikipedia*)

**Carpathian:** Europe. 900 miles (1,460 km.) in Central Europe from the Danube along the Slovak-Poland border and into Ukraine & Romania. The highest mountain is Gerlachovsky at 8,711 feet (2,683 m.). The Carpathians are an extension of the Northern Alps. They are lower than the Alps and have considerable mineral resources including natural gas. (*Carpathian Mountains – Wikipedia*)

**Cascades:** N. America. 700 miles (1,120 km) from Mt. Lassen to the Fraser River in Southern British Columbia. They are about 100 to 150 miles (160 to 240 km) east. of the Coast Range and include the volcanic peaks of the Western U.S. The highest peaks are Mt. Rainier at 14,410 feet and Mt. Shasta at 14,162 feet. Many peaks have erupted in the last 10,000 years and two, Mt. St. Helen and Lassen Peak in the 20<sup>th</sup> Century. (*Cascades – Wikipedia*)



**Caucasus** Europe. Between the Caspian and Black Seas. They are on the SW border of Russia. The range is 684 miles (1,100 km.) long and 99 miles (160 km) wide. It is made up of two parallel ranges called the Greater Caucasus and the lesser Caucasus. Its highest mountain is Mt. Elbrus, 18,510 feet (5,642 m.)

Their formation is the result of a collision between the Eurasian tectonic plate and the Arabian tectonic plate. (*Caucasus Mountains – Wikipedia*)

**Coast Mountains:** 600 miles (1,000 km.) and averages 120 miles (200 km.) in width A range of mountains extending from the Alaska Panhandle and covering most of coastal British Columbia. The west slopes are steep, coming down to the beaches and thickly covered with temperate rainforest. The range includes the largest temperate ice fields in the world. The range then tapers to the dry interior plateau. (*Coast Mountains – Wikipedia*)

**Drakensberg** Africa along the Southeast coast of South Africa and part of the escarpment. The highest of the Drakensberg mountains is Mt. Injasui at 11,180 feet (3,408 m.) There is a narrow strip between the mountains and the coast. (*Drakensberg – Wikipedia*)

**Ellsworth:** Antarctica adjoining the Antarctic peninsula that is below South America's Cape Horn. The highest mountain is Mt. Vinson (116,080 feet, 4,897 m.). (*Ellsworth Range – Wikipedia*)

**Great Dividing Range** Australia Eastern Highlands Length, 2,175 miles (3,000 km.) from the northeastern tip of Queensland to paralleling the entire eastern coastline, finally turning west and fading into the central plains. The highest peak is Kosciuszko, 7,310 feet (2,228 m.) The Mountains consist of many peaks and are surrounded by smaller ranges or spurs. There are a number of plateaus, some with jungle and farmland. In many areas the eastern Escarpment is a formidable barrier. (*Great division Range – Wikipedia*)

**Guyana Highlands** Northern S. America extending from South Venezuela through Guyana into northern Brazil. Four mountain ranges are listed north to south; the Marume Mtns., Pakarama Mtns., Kanuku Mtns., and Akarai Mtns. (*Guyana Highlands – Wikipedia*)

**Himalayas** Asia 1,500 miles (2,400 km) across Southern Asia from the Indus River in the West to the bend of the Brahmaputra River on the East and as much as 200 miles (320 km) wide The Himalayas include parts of India, Pakistan, Tibet and Nepal. The range is the result of a collision between the Australian-Indian and the Asia tectonic plates. It is still growing. It is the highest mountain system in the world. Many peaks are over 5 miles high including Mt. Everest at 29,029 feet (6,858 m). (*Himalayas – Wikipedia*)

**Hindu Kush** Asia It reaches 500 miles (800 km.) between Eastern Afghanistan and Western Pakistan. It forms a great watershed between the Indus and Amur Darya River systems. The highest peak is Tirich Mountain at 25,230 feet (7,699 m). It is a UNESCO World Heritage Site.  
*Hindu Kush – Wikipedia)*

**Huangshan** Eastern China Height about 3,300 feet (1,000 m)  
These mountains have been declared a World Heritage Site (Core area 154 sq km (62 sq miles) with a buffer area of equal extent. The area has many beautiful natural formations. (*Huangshan 0 Wikipedia)*

**Jounheim** Europe, Norway. This system is alternately rugged mountains and many deep fjords, some as much as 70 miles (100 km.) long.. It includes the tallest mountain, Galdhepiggen, in Norway. The range runs in a north-northeast direction about 700 miles (1,100 km) (*Jounheim – Wikipedia)*

**Krakor** Asia, southwest Cambodia, major watershed, Carodamom Mtns.  
*(Krakor - Wikipedia)*

**Kumlun** (Kumlun Shan) Asia, western China (Xinjiang province) a major mountain range north of the Himalayas and north of the Tibetan Plateau. The range extends east to west about 1,250 miles (2,000 km.) (*Kumlun Mountains - AOL Service Research*).

Average elevation is 1;6,000 to 23,000 feet (5,000 to 7,000 m.) The highest peak is Kongur, 25,325 feet (7,719 m.) (*Mountain Ranges of China – United Document, Internet)*

**Laurentians** Canada, Quebec, between the St. Lawrence River and Hudson's Bay. The Laurentians are believed to be the oldest mountain range in the world. The range runs northward to Hudson Strait. (*Mountain Range, Laurentian – AOL Search Research -*

**Olympic Mountains** Olympic peninsula of western Washington, U.S.A. Much of the area is a temperate rain forest with over 12 feet (365 cm.) of rain in west-facing valleys. Many trees reach great heights and attain diameters of several feet. The mountains are closely clustered and bordered on the west by the Pacific Ocean and on the north and east by Puget sound. *Olympic Mountains – Wikipedia)*

**Ozarks:** U.S.A. through parts of Oklahoma, Arkansas, Missouri, Kansas and Illinois. Much of the area is under-laid by volcanic rock and the area is believed to be of volcanic origin. The highest peak is about 2,837 feet (900 m.) and there are many flowing springs in the foothills. (*The Ozarks – Wikipedia)*

**Pacific Coast Ranges:** also known as the **Pacific Cordillera.**

North America, 2,500 miles (4,000 km)

It is a series of mountain ranges along the Pacific Coast of North America from Alaska to northern and central Mexico. They include the following ranges: the Sierra Nevada, the Sierra Madre, the Coast Mountains, the Olympic Mountains, the Alaska Range, and the Saint Elias.

The Pacific Coast Ranges have few coastal plains, mainly at the mouths of a few rivers, The Copper River, the Fraser River, the Columbia River and the Sacramento River. The northern ranges are unique in having the largest temperate rainforests in the world as well as a number of temperate ice fields, the largest in the world. (*The Pacific Coast Ranges – Wikipedia*)

**Pamirs Mountains:** “The Root of the World” North central Asia in Tajikistan. It was in part of the “Great Silk Road”. Tajikistan is 90% mountain area.

(*Pamir Mountains - Wikipedia*)

**Prince Charles Range:** Antarctica

**Pyrenees:** Europe. The range is 270 miles (40 km) from the Mediterranean Sea to the Atlantic Ocean. It forms the border between France and Spain. The range covers an area of over 20,000 sq. miles (51,800 sq. km.). Many peaks rise more than 10,000 feet (3,100 m.) above sea level. The highest peak is Pico de Aneto at 11,168 feet (3,404 m.). Iron ore is a major mineral. The mountain range is of granite with limestone foothills. (*Pyrenees – Wikipedia*)

**Qillan SHAN:** Asia, west-central China. The range is on the north rim of the Qinghai-Tibet Plateau and rise to a maximum of 17,800 feet (5,543 m.) The range is about 45 miles (60 km) south of Jiukuan and stretches 370 miles (600 km) west and merges as the Yema Shan with peaks as high as 17,220 feet (5,250 m) and Altun Shan at 19,018 feet (5,798 m). (*Qillan Shan – Wikipedia*)

**Qin Ling** (Tsiling) Asia, north China, an extension of the Kunlun Mountains. It is the range of the Giant Panda. The range divides the north China plain from the Chang-Jang delta.). The range covers about 21,000 sq mi (55,000 sq km). The highest point is Mount Taibai at 12,360 feet (3,767 m)/

The range lies between the Huang Ho (Yellow River) and the Yangtze basin. Southern slopes are subtropical with many species of plants unique to the area. The north slope tends to cold weather.

(*Qin Ling – Wikipedia*)

**Rocky Mountain Range (The Rockies)** United States, Canada.

The Rocky Mountains stretch more than 3,000 miles (4,800 km.) From the Rio Grand in New Mexico to the Liard River in British Columbia. The highest peak is Mt. Elbert in Colorado at 14,440 feet (4,401 m.).

The eastern edge of the Rockies rises directly out of the prairies of the United States and Canada. The Front Range includes such ranges as Wind River Range, the Big Horns, The Crazy Mountains and the Clark Range.

The younger ranges of the Rocky Mountains uplifted during the late Cretaceous Period, about 100-65 million years ago. Their composition is of igneous and metamorphic rock. Volcanic rock appears in certain areas. The system is quite wide. It is formed from pressure between tectonic plates.

The Rockies form a part of the American cordillera that includes the Brooks Range in Alaska, the Selkirks in the Yukon and the Sierra Madre in Mexico but are separate ranges. Separate Ranges lie to the west of the huge Rocky Mountain Trench that runs from the flathead river to the north of British Columbia River is not considered part of the Rockies.

The Rockies are rich in minerals and the Wyoming basin has large deposits of coal, oil shale and petroleum.

The Rockies form the east boundary of the Great Basin.  
(*Rocky Mountains – Wikipedia*)

**Ruwenzoi** (Rwenzoni Mountains) Central Africa, along the western border of Uganda, thought to be the “Mountains of the Moon”. The range is about 40 by 75 miles (65 by 120 km.) It is the highest range of mountains in Africa with the highest peaks, Margherita, 16723 feet (5,109 m), and Alexandra 16,640 feet (5,083 m.) The area is known for the Mountain Gorilla.  
(*Ruwenzoi Range – Wikipedia*)

**Sierra Madre** N. America the names of three mountain ranges along the west coast of Mexico.  
*Sierra Madre Oriental:* It forms the eastern edge of a central plateau. Its peaks rise to about 13,000 feet (3,600 m).  
*Sierra Madre Occidental:* The Occidental forms the Western Edge of the plateau. Its peaks are volcanic peaks ranging from 7,000 to 10,000 feet (2,100 to 3,050 m).  
*Sierra Madre del Sur:* is a mountain range in Southern Mexico. Its peaks rise to 11,500 feet (3,350 m)  
(*Sierra Madre Occidental – Wikipedia*)

**Sierra Nevada** Europe, Southeast Spain, back of the shores of the “Spanish Riviera”. The mountains rise up to over 11,000 feet (3,350 m). It is one of 6 mountain ranges in Spain. Its attractions include the city of Grenada and winter ski areas. The Sierra Nevada were formed about the same time as the Alps and the Atlas Mountains of N. Africa, from the collision of tectonic plates. The north slopes of the Sierra Nevada are very steep. Southern slopes are somewhat gentler with mountain ridges and valleys running parallel to the range. The highest mountain is Mulhacen at 11,414 feet (3,479 m.). The mountains are popular for skiing. . (*Sierra Nevada – Wikipedia*)

**Sierra Nevada** N. America 400 miles long. It is a granite mountain range in Eastern California. Its width is 40 to 70 miles (64 to 110 km.). The slope is gradual from the West. A number of peaks rise to 14,000 feet (4,300 m.). The highest is Mt. Whitney at 14,495 feet (4,389 m.). The total area of the Sierra Nevada is about 30,000 sq. miles (77,400 sq. km.). Within the Sierra Nevada are Lake Tahoe, Sequoia National Park and Yosemite National park.  
(*Sierra Nevada- Wikipedia*)

**Stanovoy** Asia southeastern Siberia, north of the Amur River, It runs east and west 450 miles (725 km.) A parallel range runs south of the Amur.  
*Stanovoy Mountains – Wikipedia*)

**Tetons** Northwest Wyoming, U.S.A. directly south of the Yellowstone National park. The outcropping is an isolated part of the Rocky Mountains and are spectacular both from a distance and from Jenny Lake on the highway from Yellowstone National park to Jackson Hole, Wyoming. There are more than 12 peaks and 4 major peaks; the highest, Grand Teton, at 13,770 feet (4,197 m) is the second highest mountain in the U.S. and the largest mountain is Mt. Moran. Slopes are very steep.

**Tian Shan** (Tianshan) Asia (China) In the Xinjiniang Province, Pakistan, India, And most of Kyrgyzstan. Average elevation is 10,000 to 16,500 feet (3,000 to 5,000 m.) The highest mountain is Tomur at 24,500 feet (7,455 m.) The upper slopes are said to have 8,000 glaciers.  
( *Mountain Ranges of China 0 United Documents, Internet*)

It is one of four major ranges in central Asia. Asia.  
(*Tien Shan – Wikipedia*)

Seismic activities continue along the edges of the range with an earthquake in August, 1992 registering 7.6 on the Richter scale. Peaks rise to a maximum of over 23,000 feet (7,000 m.) (©)

**Tibesti** Africa The Tibesti volcano complex is located in southern Libya and northern Chad, halfway between lake Chad and the Gulf of Syrte. It is a are a group of dormant volcanoes. They are the highest mountains in the Sahara..  
*Tibesti – Wikipedia*)

**Transatlantic** Antarctica Tectonic Uplift  
The Transatlantic Range forms the Western margin of the Pre-Cambrian Shield that is Eastern Antarctica. The mountain range reflects the tectonic activity and uplift that that has occurred along the pacific margin during the drifting and breakup of Gondwana and of the present. The mountain range includes a number of volcanoes. The mountain range is along a rift similar to the Great Eastern Africa Rift.

*Note: Gondwana was a super continent that separated from Pangeia. Gondwana included South America, Australia and Antarctica.*  
(*Transatlantic - Wikipedia*)

**Whitmore:** Antarctic, Elevation of the range is less than 4,000 feet  
It is an isolated range of mountains in western Antarctica .

**Yabonovy (Yablonoi):** Asia southeastern Siberia in Russia 10000 miles  
(1,4000 K.)  
The range extends northeast from northern Mongolia until it joins the *Stanov Mountains* The mountains separate the watersheds of the Arctic and Pacific oceans. The tallest mountain is Sokhondo at 8,199 feet (2,499 m.)  
(*Yablonoi Mountains – Wikipedia*)

**Zagros:** Asia, Iran The Zagros mountain range is a series of uplifts with narrow steep valley slopes between a series of compression faults caused by the collision between the Arabian tectonic plate and the Iran tectonic plate. The range of mountains runs from Northwest to Southeast on the Iranian side of the border with Iraq. The area is subject to deadly earthquakes and often accompanying landslides. (*Zagros Mountain Range - Wikipedia*)

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(a) *Encyclopedia of the nations, 2006, Volt 4, Asia.* Mongolia, p. 531

(b) *Ibid, Vol. 3, Americas.* Brazil, p 83.

© *Ibid, Vol. 4, Asia--,* Kyrgyzstan, p 435.

## VOLCANOES and HOT SPOTS by LOCATION

X (description included in section on Mountains)

### ANTARCTICA: (t)

Erebus, Mt. Ross Island in the Ross Sea, height is 12447 feet. It is the most southerly active volcano on earth. Its last eruption was in 2003.

### ARGENTINA

x Aconcagua  
 x Pissis belied to be extinct

### ATLANTIC OCEAN: (t)

Beerenberg, Jan Mayan; Is. N. of Iceland  
 La Palma Canary Is. Far W.  
 Pogo Cape Verde Is. 1955, 3 cu mi.

### CAMEROON:

X Lake Monoun NW Cameroon crater with lake  
 x Lake Nyos NW Cameroon; crater with lake

### CARIBBEAN:

La Soufriere of Guadeloupe Galapagos  
 La Soufriere St. Vincent  
 x Pelee, Monte Martinique  
 Soufriere Hills Montserrat elevation, 3,000 feet.. It is a complex volcano forming a series of domes. It last erupted in 2003. it is closely monitored

### VOLCANOES IN CASCADE , FROM SOUTH TO NORTH: (s)

x	Lassen Peak	California	North Central
	Mona Lake	California	flat caldera
x	Mt. Shasta	California	North near Oregon border
	Medicine lake Volcano	California	Northeast
	Mt. McLoughlin	Oregon	Southeast
x	Crater lake (Mt. Mazama)	Oregon	South Central
X	Mona Lake	California	E Central
	Long Valley (Caldera)		
	Newberry Volcano	Oregon	South Central
	Three Sisters	Oregon	Central Oregon just W. of Bend, Or.
	Mt. Jefferson	Oregon	about 50 miles N. of Three Sisters
x	Mt. Hood	Oregon	East of Portland, Or.
x	Mt. St. Helens	Washington	About 50 miles NNE of Portland
x	Mt. Rainier	Washington	50 E. of Olympia
	Glacier Peak	Washington	50 miles NE of Seattle
X	Mt. Baker	Washington	Just S. of Canada.
	Mt. Garibo	Br. Columbia	50 miles NE of Vancouver

Note: The Mountains lie along the subduction of the Juan de Fuca tectonic plate beneath the North American plate.

#### CHILI:

- Cerro Azul-Quizapu Southern Andes near Argentina border. 12,428 feet (3,780 m). It has a central peak and several flank calderas.
- Cerro Hudson Southern Chili
- El Tatio Geysir altitude of 14,170 feet. NW of San Pedro de Atacan.  
The area of thermal activity covers 4 sq. miles of a rift valley floor.
- Llullaillaco Northern Chili 22,060 ft. (6,739 m.)
- Vallarrica

#### COLOMBIA

- Galeras Southern Columbia complex volcano 14,029 feet.  
Frequent eruption and a weakened cone has caused many slides and debris. The mountain is closely monitored
- X Nevado del Ruiz Central Colombia 17,457 ft (5,371 m.)

#### CONGO, DEMOCRATIC REPUBLIC

- Nyamuragiro Great Rift Valley Elevation,  
It is a massive, high potassium shield volcano with gentle slopes  
It is the most active volcano in Africa, located a few kilometers NW of Nyiragongo. It has had 46 eruptions in a hundred years.
- Nyiragongo Great Rift Valley. Elevation is 11,384 feet (3,834 m),  
one of the most active volcanoes in the world. Famous for Lava Lake in its summit. Eruptions are frequent. 1977 lava flow traveled 60 miles. Both volcanoes are in the Virung Range.

#### COSTA RICA:

- Arenal NW Costa Rica on the SW shore of L. Arenal.  
(stratovolcano). The last eruption was in 2003. It became active in 1968 and has killed a number of people.
- Irazu Central Costa Rica double crater
- Poas Central Costa Rica twin crater lakes

#### ECUADOR (Andes Mountains).

- x Cotopaxi 18,300ft (6,000 m.)
- Guagua Pichinicha
- Reventador E of the main range of the Andes
- Sangay 15,940 ft.(5,230 m.)

#### EL SAVADOR

- Izalo W. El Salvador, young volcano, 1,770

#### ETHIOPIA:

- X Erta Ale Active lava lake (shield volcano) .

#### FRANCE

- Chine e Puys in the Auvergne region of central France; 4,800 feet (1,46 m), The last eruption was about 4,000 B.C. It is a series of cinder cones and lava domes formed by ejected debris. The last eruption included powerful explosions.



Chaudes-Aigues Hot Springs. They are 60 miles South of the *Chine e Puys* but it is believed that the source of the heat is located in that area.

#### GALAPAGOS IS.

Fernandina

#### GERMANY

West Eiffel Field In the Rhine Valley S. of Cologne., height 1,968 feet. (magma cinder come) . The last eruption was between 7,000 and 11,000 years ago. For a time it had almost daily eruptions, forming a great number of Strombolian alternating with pyroclastic eruptions, creating about 240 small cones:  
Note: Stromboli erupts daily, sometimes like “Old Faithful”.

#### GREECE

x Santorini Island S. of Greece near Turkey

#### GUATEMALA

Atitlan SW Guatemala on the S. rim of a large crater.

Fuego

Pacaya

two small cones and a lava dome, active

Santa Maria

W. Guatemala growing lava dome

#### ICELAND

Askja

complex volcano with a mile diameter caldera.

Geysir

50 miles E of Reykjavik.

Grimsvotin

height is 5,689 feet (1,165 m).. It is Iceland’s most active volcano. Eruptions under the ice cap have caused gigantic foods. Last eruption was in 1998.

Hijamaey

Vestnarian Is.

Hekla

eruptions with both ash and lava

Krafla

N Iceland, large caldera, dormant

x Laki

S Central Iceland fissure zone over 15 miles long/

x Oralefajokul:

glacial melt

x Surtsey

Lava cone & island of S. coast of Iceland

#### INDIA

Karthala

Grand Comoro Is.

Piton de la Fourn

Reunion Is. It has frequent lava flows

#### INDONESIA

Agung

Bali 196e eruption killed 20,000 people

Colo Una

1,620 ft (500 m.) small crater lake, explosion

In 1983.

Dieng

Java complex volcano, 26 cones

Galunggung

W. Java Dangerous volcano with few eruptions

Gamalama

Gamalama Multiple craters & lakes. Frequent eruptions

Kelut

E Java Multiple craters & crater lakes. In 1919, 5000

died.

x Krakatau

(see text)

Merapi

C. Java 9737 feet 2,968 m). Frequent and violent

explosions. There are frequent pyroclastic flows and lahars causing destruction and loss of life throughout history.

- Semeru E. Java 11,850 ft (3,620 m.) frequent eruptions, many violent.
- x Tambora Sumbawa (see text)
- x Toba SE Sumatra (super volcano) (*see Lakes*)
- IRELAND
- Antrin Plateau Ireland and surrounding areas, height up to 800 feet  
Last eruption was 55 million years ago. (fissure vent volcano.)
- ITALY
- x Etna Sicily (see text)
- Lardarello Tuscany, Central Italy, one of the world's largest Geothermal fields. Electric power has been generated since 1901. (It may be a super hot spot)
- Lipari Island 22 miles N. of Sicily and is in an active volcanic arc. This is the result of the subduction of the African Plate under the Eurasian Plate and partial melting of the edge of the African Plate. It is feared that Explosion may occur. See Vulcano.
- x Nuovo, Monte Bay of Naples, new volcano
- x Stromboli (see text)
- Solfatara West of Vesuvius on the N. shore of the Bay of Naples. In a crater within a crater, the area has many intense geysers.
- x Vesuvius (see text)
- Vulcano Island of Vulcano W. of Italy. Strong eruptions 200 years apart.
- JAPAN
- Asam Central Japan Most eruptions at 15 yr intervals. In 1783 a major eruption with mudflows killed 1,300 people.
- Aso multiple volcanoes over 150 sq miles with many minor eruptions.
- Bandai N Central Japan few but violent eruptions, one with cubic mi. of lava.
- Bayonaise Ocean SE of Japan, Eruptions build temporary islands.
- Beppu Kyushu, in Northeast. Hot springs. Steam is used for power. It is Japan's largest spa area.
- x Fuji (see text)
- Nagano In Japan Alps N. of Tokyo; famous for hot springs and fumaroles. Japanese mamacaique monkeys bathe in the hot waters.
- Oshima off E coast of central Japan. Eruptions about every 30 years, many with lava flows.
- Sakrajima In Kongoshima Bay It is one of the world's most active Volcanoes with thousands of explosions. Some with lava flows.
- Unzen W coast of S Japan. Only six eruptions in 1,200 years. In

- 1792, an eruption was accompanied by earthquakes, slide, and a tsunami causing 14,000 deaths. Last eruption was in 1996.
- Usu N. Japan. Eruptions are only every 50 years but explosive and destructive. Lava domes and land uplifts are common
- KENYA**
- Bogoria It is In Lake Bogoria at the foot of the Laikipia Escarpment. Volcanic springs feed soda lakes, which are feeding ground for flamingos.
- X Kenya extinct volcano
- KOREA, NORTH**
- X Baekdu, Mount Stratovolcano,
- MADAGASCAR**
- Piton de la Fourna It is in the Indian Ocean off the E. Coast of Madagascar Height is 8,0063 feet (2,400 m), It Is a shield volcano, last eruption in 2002; one of the biggest & most active volcanoes in the world, a hot spot under Indian ocean.
- MEXICO**
- X El Chichonn S. Mexico Lava dome mountain. It was inactive volcanic and dormant until 1982. Eruption and lava flow killed more than 2,000 people..
- Colima W. Central Mexico. Elevation 12,660 feet (3,700 m). Eruptions are 100 years apart. The last eruption was in 2003.
- X Paracutin (see text)
- X Popocatepetl (see text)
- Sierra la Primavera *Rhyolite Caldera Complex* near Guadalajara height, Elevation, 7,440 feet (2,176 m). Last eruption was in prehistory.
- NEW ZEALAND**
- Ngauruhoe Central N. Island Explosive eruptions about every 3 years.
- Rotorua It is in the town of Rotorua near L. Rotorua with geysers, hot springs and fumaroles. Wells tap heat from underground for domestic use. Geyser Flat has a number of geysers including a triple geyser.
- Ruapehu Central N. Island Height is 9176 feet (2,796 m). There are frequent eruptions with steam and ash. Mud flows Occasionally cause damage in adjacent valleys. Last eruption was in 1997.
- Tarawera Central N. Island volcanic complex along a 10-mile fissure. An eruption in 1886 ejected about ½ cubic mile of basalt & ash. (see text)
- X Taupo volcanic area *Rhyolite Caldera Complex* (super volcano) near and including Rotorua. The area was the scene of a super explosion about 180 A.D. pyroclastic flows devastated the area.

	Wainang	North Island in Wainang Valley near Rotorua. Fumaroles. It may be part of the super volcano. It was regarded as New Zealand's Yellowstone until a violent explosion of Tarawera in 1880 obliterated these features.
	White Island	Volcanic island N. of New Zealand.
NICARAGUA		
	Cerra Negro	W. Nicaragua, born in 1850. It erupts frequently, usually with lava.
X	Coseguina	W. Nicaragua, crater lake. Elevation is 2,085 feet (636 m) The last eruption was in 1859. A major eruption in 1835 affected areas 300 miles away.
	Masaya	SW Nicaragua between L. Nicaragua & the Pacific Ocean. There are frequent eruptions with varied explosions. It is one of Nicaragua's most active volcanoes. Its caldera is 7 miles (11 km) wide.
PACIFIC OCEAN		
	Ambrym	New Hebrides Large caldera with frequent eruptions, some violent.
	Pagan:	Mariana Is. It has many small eruptions & one large.
	Raoul	Kermadec Island N. of New Zealand. It is noteworthy because of earthquakes before eruptions.
	Yasour	New Hebrides Is. It is in almost constant eruption.
PAPUA:		
	Karkar:	volcanic island off N. coast of Papua, New Guinea.
	Lamington:	E. Papua dormant until 1951. The explosion destroyed 80 sq miles, (200 sq km.) and killed about 3,000 people.
	Mamam:	Volcanic Is. Off N. coast of Papua with frequent eruptions.
X	Rabaul:	<i>Rhyolite Caldera Complex</i> New Britain. A group of small volcanoes around a caldera bay. The last eruption was in 2003.
PARAGUAY		
	Parana Plateau	Central Paraguay and into both Argentina and Brazil. The elevation is up to 3,300 feet (1,000 m). (fissure vent volcano) Inactive. About 120 million years ago its eruption covered 20,000 square miles (51,000 sq km). (super volcano)
PERU		
	El Misti:	A classic cone rising high above city of Arequipa.
PHILIPPINES:		
	Mayon:	Central Philippines highly populated area.
x	Pinatubo	(see text)
	Taal	<i>Rhyolite Caldera Complex</i> W. coast of Luzon. It is a large caldera lake. It has had previous eruptions with tsunamis and large loss of life. The last eruption was in 1977. A 1960 eruption killed 200.
RUSSIA		

- Bezmyamiy Kamchatka It has mostly explosive eruptions about every 10 years.
- Krymky Kamchatka Eruptions are mostly explosive at 10 yr interval.
- Kliuchevskoi Kamchatka, Siberia Height is 15,863 feet. Eruptions are mostly explosive & 10 yr. Intervals. The last eruption was in 2003.
- Siberian Traps Central Siberian plateau; up to 1,650 feet (500 m), fissure volcano, Its last eruption was about 250 million years ago. The area of lave covers over 116,000 sq. miles (284,000 sq km).
- Tolbachik Kamchatka, Siberia major cinder & lava eruption in 1975.

#### SPAIN:

- X Lanzaro Canary Islands
- Paco de Teide Canary Islands, on Tenerite Is., 12,188 feet (3,715 m). Last eruption was 1909. It in a larger caldera.

#### TANGANYIKA:

- x Kilimanjaro on the equator, dormant

#### TANZANIA

- Ol Doinyo Lengai N. Tanzania elevation, 9,466 feet ( 2,885 m). Last eruption was in 2003 The lava is the most liquid in the world.

#### UNITED STATES – ALASKA

- Augustine Island in Cook Inlet Several explosive eruptions in a Century.
- x Katmai (see text) major volcano
- Pavlof: SW Alaska about 40 moderate eruptions in 300 years.
- Novarupta Alaska-Katmai. Elevation 2,7670 feet (845 m) *Rhyolite Caldera Complex*. Last eruption was in 1912. It was formed by the largest eruption in the 20<sup>th</sup> century.
- Redoubt SW Alaska visible from Anchorage. Infrequent eruptions. The last eruption in 1989-90 created large cloud and mudflows that threatened the Cook Inlet.
- Shisaldin: E. Aleutians It is a classic cone with small to moderate eruptions.
- Valley of a Thousand Smokes. (hot spot) It is located in the Aleutian Chain, NE. of the Alaskan Peninsula. In 1912, the Ukak Valley was filled by the largest pyroclastic flow in modern history, pouring from vents near Mount Katmai. For many years, steam poured from holes in the lava.

#### UNITED STATES – HAWAII:

The Hawaiian Islands are the latest in a chain of islands formed as the Pacific plate moved over a hot spot or great magma chamber. This movement is about 4 inches per year. There are seven major islands and a cluster of small islands in the area of Molokai and Maui. They range from Nihau (the oldest), Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii (the youngest). Some islands are built from a single volcano. Oahu were formed of a ridge and a separate volcano. Molokai was formed from a continuous

ridge. Maui (the valley island) had two volcanoes. Hawaii (the Big Island) owes its existence to 5 volcanoes. Even now a subterranean volcano is forming to the South of Hawaii. Whether it will become a part of Hawaii or form a separate island remains to be seen.

*Hawaiian peaks are described in section on mountains.*

- HAWAII (Island of):
- x Hualalai: West – 8,271 ft (2,521 m),
  - x Kilauea: Southeast - 4,091 ft (1,247 m)
  - Kohala: North – 5,480 ft (1,670 m)
  - x Mauna Kea: Northeast and part of the center – 13,796 ft (4,205 m)
  - x Mauna Loa: The central part of Hawaii - 13,679 ft (4,169 m)
- MAUI:
- x Haleakala 10,023 feet (3,055 m.) (observation deck and visitors center)

#### IDAHO:

Soda Springs: Geyser, hourly. A well tapped a chamber of mixed hot water and carbon dioxide. A valve at the well head allows a timed geyser.

The area has a number of hot springs.

#### NEVADA:

**Fly Geyser:** elevation is 4,270 feet (1,301 m). It is a continuous flow geyser and has built up a number of calcium carbonate peaks. The adjacent Black Rock Desert is the dry bed of a lake that once covered 8,660 sq. miles 22, 300 sq km).

**Long Valley:** *Rhyolite Caldera Complex* Caldera is about 10 x 20 miles with elevation of 6,500 feet in SE and 8,500 feet in SW. Last major explosion was about 730,000 BP, with 1,500 cubic miles of ash that covered almost 1,000,000 sq miles to E and S, comparable to Yellowstone. The magma chamber continues to feed eruptions in the Long Valley and Mono, Inyo areas. *Long Valley Caldera and Mono-Inyo Volcanic Field, California (Internet)*. It is partially in California..

#### NEW MEXICO

VALEES CALDERA: (Super Volcano) 12 mi. diameter caldera and with last eruption about 50-60,000 years ago. It is in a National Preserve with active fumaroles & hot springs. (*Vales Caldera-Wikipedia*)

#### WASHINGTON, U.S.

Columbia Plateau (up to 6,000 feet) super volcano exploded about 2 million years ago. Lava flow covered over 2,000 sq. miles (3,000 sq km).

#### WYOMING, U.S.

- x Yellowstone (super volcano) also listed as a Hot Spot

#### ZAIRE

Nyamura: East Zaire, shield volcano with lava lake. It is fairly active & moderate.

Nyiragongo: E. Zaire Summit caldera, with eruptions every 10 to 20 years with lava lake and lava flows, with some fatalities.

## MOUNTAINS

(*Highest Mountain Peaks of the World – Infoplease.com*)

- ACONCAGU: (volcano) (probably extinct) 22,835 feet (6,959 m.)` (Argentina)  
Highest mountain in the Western Hemisphere.(p)
- AKURANB: (Alaska, U.S.A.)
- ANCOHUMBA: 23,012 feet (6,829m.) (Bolivia)  
The Atlas lists this as the second highest mountain in the Western Hemisphere.
- ANNAPURNA: 26,504 feet (8,076 m) Nepal, Himalayan mountains.  
Prior to 1956, it was the highest mountain ever climbed.
- ANTRIM PLATEAU: (volcano), *Fissure Vent*, Height is up to 1,880 feet (573 m). Count  
in northern Ireland. The last flow was about 55 million years ago.
- ARARAT (Mt. Massis) 16,849 feet (5,000m.) (Eastern Turkey, near Lake Van)  
Supposed site of Noah's Ark. (a)  
Mt. Massis is in the land of Ararat, a land surrounding Lake Van.
- ARENAL: (volcano) *stratovolcano* height 5,465 feet (1,666 m). (Costa Rica),  
southwestern shore of Lake Arenal. *It is active*. It is a spectacularly beautiful  
cone shape rising out of the San Carlos plain. *AOL Search for mountains/Arenal*)
- BAEKDU MOUNTAIN (N. Korea &China) *Stratovolcano*. 9,003 feet el. (2,744 m.  
The entire mountain is new being raised by rising magma. The mountain had a  
major eruption in 976 (app.) with a cataclysmic explosion of about 65 cubic miles  
of pyroclastic materials. The Chinese area is a popular tourist attraction. The  
ground is warming and many trees have died. Up to 100 tiny earthquakes daily  
are being recorded in 2011. *Wikipedia, Baekdu Mountain*.
- BAKER, MOUNT (volcano) *Strata volcano* 10,778 feet (3,290 m.). (Oregon, U.S.A.)  
Its glaciers have the Most crevasses in the States. It averages 647 inches of snow  
fall per year, the highest of any mountain in the United States..  
(*Baker, Mount, Wikipedia*)
- BLANC, MOUNT: 15,771 feet. (4,680 m.) (France, Italy, Switzerland)  
“Highest mountain in the Alps” (a)
- BONETE (Cerro Bonete): 22,540 feet (6,889m.) Central Andes, (Argentina) it is  
the 4<sup>th</sup> highest mountain in America (*Cerro Bonete, Wikipedia*)
- CHAINE DE PUYS: (volcano) *Caldera Cones, Lava Domes*, ovation is in the Au  
vergne region of central France. Last eruption was about 4,040 B.C. It was first  
formed about 70,000 years ago. *Mount Chain De Puy - Wikipedia*



CHIMBORAZO: 20,561 feet (6,267 m.) (Andes in Ecuador). It is one of the highest mountains in the Western hemisphere. The area is a tourist attraction.  
*Chimborazo Volcano – Wikipedia)*

COLIMA, (volcano) *Stratovolcano* 12,604 feet (3,842 m), (Mexico, Colima) combined with an older cone of 14,143 feet (4,310 m), it is in the volcanic belt of S.W. Mexico. It is the most active volcano in Mexico. Its caldera is 3 miles wide. Its last eruption began in 2007 and continues at this time. Massive collapse events occur every few thousand years. *Colima – Wikipedia*

COLUMBIA RIVER PLATEAU: (volcano *flood Basalt*) (U.S.A.) It ranges from Idaho through Washington and Oregon to the Pacific. It covered 63,000 sq miles (163,000 sq. km.). Over a period of 10 to 15 million years, a thickness of over 6,000 feet (1,800 m.) the flow occurred about 125 million years ago. The subsidence of the crust produced a slightly depressed lava plain known as the **Columbia River Basin or plateau/** (*Columbia River Plateau – Wikipedia*)

COOK, MOUNT 12,349 feet (3,765.4 meters). (New Zealand. South Island.) It is the highest mountain in New Zealand. It is in the central part of the New Zealand Alps. (d)

COSEGUNA (VOL): (Nicaragua) (b) It is on the Pacific coast and across a bay from a Union. Eruption on 20 January, 1835, lasted several days and some areas had no sunlight for days. (A-1)

COTOPAXI: (volcano) *Stratovolcano* 19,347 feet (5,752m.) (Ecuador)  
It is located at the southern end of the Cordillera range of N. Ecuador.  
It is one of the highest volcanoes in the World. An eruption in 1877 killed about 1,000 people. (p)

CRATER LAKE (volcano) *Caldera* : (Mt. Mazama) elevation 6,200 feet (1,900 meters) (Oregon, U.S.A.) “This lake, the deepest lake in the United States, fills a 10 kilometer wide (6.31 miles) caldera that was formed by the great eruption and collapse of Mount Mazama volcano about 7,700 years ago.” (q)  
The mountain was about 13,000 feet (4,000 m) elevation before the explosion and  
It covers 20 square miles (32 sq km.) *also see* Lakes (Crater Lake)/

DINALI (Mt. McKinley) *see Mt. McKinley* (Alaska, U.S.A.).

DHAULAGRI: 26,795 feet (7,951m.) (Nepal )

EL CHICHON (volcano) *Lava Dome* 3,478 feet (1,032m.) (Mexico)

An eruption in 1982 killed 187 people and released carbon dioxide gas high into the air. (p)

ELBERT, MOUNT elevation, 14,440 f335 (4,401 m) Colorado, U.S.A.

Rocky Mountains, approximately 10 miles (16 m) south of Leadville, CO. It is the second highest mountain in the contiguous U.S. *Mount Elbert - Wikipedia*

EREBUS, (Elbrus) MOUNT: (volcano) *Stratovolcano* 18,488 feet (5,486m.)

(Southwestern Russia) in the Caucasus. The volcano is currently active. It is the highest mountain in Europe. (e)

ERTA MT.: (volcano) *Shield volcano*, elevation, 2,010 feet (613 m). It is located in northeast Ethiopia, It rises from below sea level. The mountain is 20 miles across with a one-mile wide caldera. It is an extremely active volcano with a considerable flow of lava.

Volcanic Eruption in March of 2007. *BBC News, Africa :Fears after Volcano Eruption*)

ETNA, MOUNT: (volcano) *Stratovolcano, composite type* 11,122 feet (3,390 m.) (Sicily, Italy)

The base is about 100 miles (160 km) around. It extends to the sea on the E. coast. Volcanic eruptions are quite violent. There have been at least 260 eruptions in the last 2,700 years. An eruption in 1683 killed over 20,000 people. The mountain is picturesque with a snow-covered peak with forests and villages on the slopes. (f)

The mountain has gentle slopes and covers an area of 1250 sq. km. (5110 sq. miles). The soil is rich so the slopes are cultivated in spite of the danger. The eruption of 1669 cost between 60,000 and 100,000 lives. (A-2)

The eruption of 1669 had a flow of almost one cubic km (1.1 million cubic yards) of pyroclastic flow. Thousands of years ago, a large landslide on the east slope caused a major tsunami in the eastern Mediterranean Sea. *Mount Etna - Wikipedia*

EVANS, MOUNT: 14,009 feet. (4,280 m.) It is one of the highest peaks in the Rocky Mountains. . It is possible to drive to the top where there is a rest station and museum. (*AOL Search results for mountain/Evans*)

EVEREST, MOUNT: 29,029 feet (8,848 m.) (Nepal-Tibet border) The highest Mountains in the world.

A large number of individuals and groups have attempted to scale the peak. Many have perished and others have had severe frostbite. (a)

FORAKER MOUNT: 17,400 feet (5,303m.) (Alaska, U.S.A.)

FUJI, MOUNT: (volcano (*Stratovolcano*) 12,385 feet (3,776 M.) (Honshu, Japan)

It is the highest mountain in Japan. It is well known for its beauty. Many have climbed the mountain to commit suicide. (g)

It last erupted in 1707. The Fuji “Five lakes” area was formed when lava flow blocked rivers to the north (*Mount Fuji – Wikipedia*)

GALERAS: (volcano) *Caldera Complex* height, 14,028 feet (3,160 m), (southwest Colombia)

It is now a cone, formerly, about a million years ago, similar to a Rhyolite Caldera. (*Galeras – Wikipedia*)

GERRO AZUL-QUIZAPU: (volcano) *Stratovolcano*, height, 12,429 feet (3,780 m), (central Chili, near the border with Argentina).

It has a 1,000-foot crater and several cinder cones, and is active.

GRAND TETON: height is 13,770 feet (4,210 m.) The mountain is one of the Teton mountains, an isolated part of the Rocky Mountains. Its slopes are very steep and the view is considered one of the finest in the world. (*Grand Teton – Wikipedia*)

GRIMSVOTN: (volcano) *Caldera*, Height is 5,635 feet (1,718 m), (Iceland). It is Iceland’s most active volcano. (*Grimsvotn – Wikipedia*)

HALEAKALA: (volcano) *shield volcano* 8,271 ft (2,521 m) Hawaii, U.S.A. The last eruption was in 1801. The volcano lies more or less due west of the saddle between Mauna Loa and Mauna Kea. Rock is about 128,000 years old.

HEROUBREIO: (volcano) (*Tuva*) height 5,518 feet (1,682 m.) (eastern Iceland). The volcano, last eruption in Pleistocene era. (*Heroubeio, Wikipedia*)

HOOD, MOUNT (volcano) *Strato volcano* 11,283 feet (3,442 M.) (Oregon, U.S.A.) It is in northwest Ore near Portland. It is a majestic, snow-covered mountain with many glaciers. The last eruptions were from 1845 to 1863. Eruptions were minor. The mountain has year-around skiers and visitors. (h)

IXTACIHUATL 17,343 feet (5,286m.) (plateau of Mexico)  
Aztec name for white woman. (a)

JUNGFRAU 13,642 feet (4,138 m.) Switzerland (a)

K-2 (GOODWIN AUSTEN) 28,286 feet (8,611 m.) (Kashmir) Himalayas  
It is the second highest mountain in the world. (a)

KANCHENJUNGA, MOUNT: 28,140 feet (8,590 m.) (Nepal-India)  
It is the 3<sup>rd</sup> highest mountain in the world. (a)

KATMAI: (Volcano) *Stratovolcano Rhyolite Caldera Complex* (Alaska, U.S.)

Elevation, 6,710 feet (2,047 m.) The mountain is about 6 miles (10 km) in diameter. It had a major eruption, 1912, the largest outpouring of lava in the 20<sup>th</sup> Century, Its central cone has a lake 3 miles across but a new vent has had several eruptions since 1912. The mountain has caldera with a lake that is about 800 feet (2,420 m.) The caldera is 3 x 2 miles (4.5 x 3 km.). A minor eruption emptied the lake in 1919.

The 1912 eruption occurred in a vent alongside the crater and was violent. On June 6-8, 1912, the most spectacular eruption in recorded history occurred. The volcano emitted over 2 cubic miles (12 cubic km.) of magma, producing about 8.5 cubic miles ((35 cubic km.) of teph. Ash flow traveled 12 miles ((20 km.) into the Valley of Ten Thousand Smokes. This is the only Alaska eruption in which rhyolite was present. Ash fell in Puget Sound 1,500 miles (2,400 km,) away.

The presence of Rhyolite, the extent of the eruption and the nearness of the Valley of Ten Thousand Smokes seems to suggest this may be a *Rhyolite Caldera Complex*.

(*Mount Katmai – Wikipedia*)

KENYA, MOUNT: (volcano; possibly extinct) 17,088 feet (5,208 m.) (Kenya)

Although it is on the equator, it has glaciers on its upper slopes. (i)  
“Base straddles the Equator.” (a)

KILIMANJARO: (Volcano) *Stratovolcano* 19,340 feet (5,895 m.) (Tanganyika)

Its last date of eruption is unknown. It is probably related to the Great East African Rift. It is an isolated peak and the highest mountain in Africa. (a)

KILIUCHEVSKOL: (volcano) *Stratovolcano* height, 15,865 feet (4,760 m.) . Near the east coast of Kamchatka peninsula of Siberia. Eruption occurred in 2005. It is the largest of a chain of volcanoes on the peninsula.

KILAWEA: (Volcano) *Shield volcano* height is 4,091 feet (1,247 m.). Hawaii, U.S.A. It is active with almost continuous flow of lava Kilauea is a collapsed cone adjacent to the summit caldera of the active Volcano. In 1959, after 3 month warning, a total flow in November and December came to 93 million cubic yards (77 million cubic meters) of lava. (*Hawaii’s Volcanic National Park, Internet*)

KOHALA: (volcano) *shield volcano* height is 5,480 ft. (1,6700 m) Hawaii, U.S.A. Its last activity was about 120,000 years ago. Its base is partially covered by eruptions from Mauna Loa and Mauna Kea. About 250,000 to 300,000 years ago a large landslide on the North flank of the mountain collapsed lapsed into the ocean, traveling about 100 miles (160 km) across the ocean floor.

KOSCIUZKO: 7,310 feet (2,228 m.)(Australia) Australian Alps.

“It is the highest mountain in Australia” (a)

- KRAKATAU:** (super volcano) *Rhyolite Calde4ra Complex* 2,667 feet (813 m.)  
 (Indonesia, in the strait between Sumatra and Java)  
 Eruption from 20 May; 59 20 Aug, 1888. The major explosion was heard in Madagascar, 3,000 miles (4,800 km) away and created sea waves almost 130 feet (30 m) high, drowning about 36,000 people. (p)  
 The enormous explosion on May 20, 1883, was only the beginning. Thousands of people died.. After a great number of lesser explosions and a plume that soared many miles into the sky, the volcano continued lesser activity until August 26 and 27. The explosion on August 27, killed more than 30,000 people with hot pumice and ash and a tsunami that exceeded 30 meters (100 feet). Waves from the May and August explosions were noted on oceans around the world. (A-3)
- LAKI VOLCASI:** (Volcano) (Iceland,)  
 Major eruption, 7 February, 1783, it was the largest flow of lava in recorded his tory. “—damage was more widespread, disasters, including a famine, an very hot July, then very cold winter, and a weird blue haze over much of Europe. The haze and the cold winter are believed to have been caused by the Laki eruption. Most of the livestock in Iceland perished and a fifth of the population starved. (A-5)
- LAMZAROTE (Volcano):** (Canary Islands)  
 Eruptions from 1730 to 1736, changed the landscape of the entire area.(A-6)
- LASSEN PEAK:** (volcano) *Strato Volcano* 10,457 feet (4,478 m.) (California, U.S.A.)  
 Cascade Range, Southeast of Mt. Shasta. One of the few U.S.A. active volcanoes. The last eruption was in 1921. (p)
- LOGAN, MOUNT** 19,850 feet (5,951 m.) (Canada)  
 t is in the St. Elias Range in SW Yukon Territory, and in Kluane National Park. It is the second highest mountain in North America. (j)
- MARGHARITA:** 16,795 feet (5,119 m.) Congo, Uganda)  
 (*AOL Search research fir mountain, Margharita*)
- MAKALU, MOUNT:** 27,827 feet (8,481 m.) (Tibet-Nepal)  
 It is about 10 miles South of Mt. Everest. (k)  
 “It is the fourth highest mountain in the world.” (a)
- MASAYA (volcano)** *Pyroclastic Caldera Complex shield volcano*, elevation 2,000 feet (633 m.) in the Central American Volcanic belt and about 15 miles (25 km.) south of Managua, Nicaragua. It has a nested set of calderas of basaltic lava and tephri. About 2,500 years ago an eruption of 2 cubic mile (8 cubic km.) lava built up the cone, caldera 7 miles wide with more than a dozen vents, surrounded by walls almost a thousand feet high. The last eruption was in 2005. There have only been 2 lava flows since the 16th century. The area has been made into a National Park.

Masaya is one of 18 separate volcanic centers that make up the Nicaragua portion of the Central American volcanic belt. These volcanoes are formed by the subduction of the Cocos Tectonic Plate beneath the Caribbean Tectonic Plate. (*Masaya Volcano – Wikipedia*)

MATTERHORN: 14,692 feet (4,478 m.) (Switzerland-Italy border) Swiss Alps “It is favored for daring mountain climbing” (a)  
A railroad runs to Zermat, Switzerland. A cog railroad takes tourists to a high elevation that furnishes excellent views. (*Matterhorn – Wikipedia*)

MAUNA KEA: (volcano) *Shield volcano* 13,790 feet (4,203 m.) Hawaii, U.S.A.)  
Its last activity was about 4,400 years ago. “World’s greatest rise from base to peak” It is the tallest mountain in the world, extending from the sea floor about 19,000 ft (5,8900 m), a total of about 33,000 ft. (10,0jj0 m)(a)

MAUNA LOA: (volcano) *Shield volcano* 13,677 feet (4,169 m.) (Hawaii, U.S.A.)  
The last eruption was in 1984. It is the world’s largest volcano, rising about 30,000 feet from the ocean floor and measuring about 60 miles wide at the base.(p)  
“—1984 eruption poured from a vent at 2,900 meters (9,350feet) elevation and traveled 25 km. (15 nuked) in 5 days to an elevation of 900 meters, (2,950 feet) , only 4 miles (6 km) from Hilo.” ®

MCKINLEY, MOUNT: (Denali) 20,320 feet (6,194 m.) (Alaska, U.S.A.) South Central Alaska, It is the highest peak in N. America and one of the tallest mountains in the world. It is also officially called Denali and is in the Denali National Park.(k)

MERAPI: (Volcano) *Stratovolcano* (Central Java, Indonesia) altitude 9,616 feet (2,914 m.). Typically, small eruptions occur every 2 to 3 years and major eruptions occur about every 10 to 15 years. A major eruption in 1930 killed over 1400 people by a pyroclastic flow. An eruption in 1,000 A.D. is claimed to have covered all central Java with ash.. Major eruptions occurred in 1994 and 2006. Seismic stations and evacuations limited the loss of life. *Mount Merapi – Wikipedia*)

MONA LAKE: (volcano) (California, USA) E. base of Cascades & Great Basin  
The Mono crater, rising to 2,000 feet (600 m) above the lake, formed 600 to 20,000 years ago. They dominate the S. portion of the basin. The last eruption is less than 2,000 years ago. There is no sign of a caldera or activity as of 1996. (see also lake). (See: Long Valley Caldera, p. 93)  
No available reference indicates the potential for future eruptions. Its lack of a crater buildup hints of the possible presence of a super volcano.

MONT PELEE: (volcano) 4,583 feet (1,397 m.) (Martinique)

“Glowing cloud from 1962 eruption destroyed the city of St. Pierre, killing about 30,000 people in minutes.” (p)

MONTE NUOVO: (Volcano) *Strata volcano* 5,000 feet (1,525 m.) (Italy) (North shore of the Bay of Naples.) It's the first written record of the birth of a new volcano. It is now 3,000 feet (900 m) high and showing some signs of renewed activity.

“It was a small eruption, but the land had been swelling for decades”.

Along the shore some land, part of a Roman Temple partly submerged a number of times over the Centuries. There had been numerous earthquakes between 1,400 and 1,538. Finally, on September 5, 1538, the ground opened up. IN October of 1538, the new volcano became quiescent. Although it is now covered with trees and shrubs, the area has had a great many tremors and a number of damaging earthquakes.(A-7)

MONTE ROSA: 15,203 feet (4,634 m.) (Switzerland) It is located along the Italian border and is only a few feet lower than Monte Blanc. It is known for spectacular glaciers. Excellent views are in the Aosta Region valley of Italy.

NEVADO DEL RUIZ (Volcano) *Stratovolcano*, 17,717 feet (5,400 m.) (Madras Pr., Ecuador ) It is S. America's second deadliest volcano, having year-round snow and ice caps creating the danger of floods during eruptions.” Eruption in 1983 triggered mud slides and floods destroying the city of Armero and killed about 25,000 people.” (p)

“The eruption of the volcano gave a year's warning and was quite small for its type when it came. But it melted part of the ice cap, forming mud slides - - “. (A-8)

NOVARUPTA (volcano) *Caldera, lava dome*. Alaska, U.S.A. in the Aleutian Range. height, 8,565 (2,610 m.) feet. It sits below Mount Katmai in the Kaltmal region. It was formed in 1912 by the biggest eruption in the 20<sup>th</sup> century. Seven cubic miles of ash and silica was ejected in 60 hours. It is located in the Valley of Ten Thousand Smokes. *Novarupta – Wikipedia*)

NYOS LAKE: (volcano) 3,571 feet (1,091 m.) (N.W. Cameroon near border with Nigeria) On 21 August, 1980, a large cloud of carbon dioxide rose from the bottom of the lake , killing 1728 people and a great many birds and animals as it rolled down the slopes. There are many fissures with some outgasing. Rainfall is 80 inches (2 meters) so fissures fill quickly. The lake is about 100 years old. Gas apparently is coming into the lake from below. The pressure of water is enough to liquefy the gas or to be absorbed. Eventually the concentration is sufficient for a sudden release of gas. (A-4)

NYIRAGONGO: (volcano) *Stratovolcano*, height, 11,384 feet (3,470 m). It is located in the Democratic Republic of the Congo just west of the boarder with Rwanda at the south end of the western fork of the East African Rift. It is one of the most active volcanoes in the world. It is famous for the lava lake at its sum-

mit. The lave is of low silica content and is very fluid. A fissure break during an eruption allowed a flow down the side of the mountain, killing many people and destroying villages. In 2002, a 8 mile (13 km) fissure in the south flank allowed a major flow of lava to reach the city of Goma. 400,000 people were evacuated. y 120,000 were rendered homeless. Continued eruptions have partially refilled the crater. *Mount Nyiragongo - Wikipedia*

OITLALTEPETL: 18,700 feet (5,700 m.) (Mexico)

OJOS DEL SALADO: Andes Mountains (volcano) 22,539 feet (6,870 m.)  
(Argentina) South America's second highest mountain..  
(*AOL Search research for /Ojos del Salado*)

OL DOIMYA LEMGAI: (volcano) *Stratovolcano*. The height is 9,482 feet (2,890 m).  
It is at the southern end of the Eastern African Rift in northern Tanzania. The cone of this volcano was built up, beginning about 370,000 years ago. The viscosity of the lava is similar that of water. The volcano is active with its last activity in 2003.

OLYMPUS, MOUNT: 9,970 feet (2,917 m.) (Greece)  
"Considered the home of the Gods." (a)

ORAEFAJOKUL; (volcano) Iceland.  
On 27, August, 1727, with eruptions lasting a full year and glacial melt, causing floods that destroyed five cities. Eruptions continued until the following April. It was decades before the valley was restored for grazing. (A-9)

PARACUTIN: (volcano) *Cinder Cone* 9,213 feet (2,808 m.) (Mexico,)  
On Saturday, 20 February, 1943, was the birth of a new volcano.  
It built a cone of cinders 5,000 feet (1,500 m) high in 6 days. (p)  
It literally ran out of gas and its last flow was 4 March, 1952. It is believed by many to be a dead volcano. (A-10)

PELEE MONTAGNE (volcano) *see Mont Pelee*  
(The Pearl of the W. Indies) 21-23 Apr 1902. For centuries, Mt. Pelee was considered a minor volcano with occasional minor eruptions, the last in 1880 with an earthquake that killed 400. From 4 June, 1900 to 23 April, 1902, Mt. Pelee funed and fussed. Then there began a series of minor eruptions, gradually building up to May 8, 1902. Saint Pierre was 7 km (4 miles) from the mountain, a beautiful city of 27,000, and a commercial center for Martinique. At 8:00 A.M., tremendous explosions were heard and, within minutes, the city of St. Pierre was destroyed. Of a total of 27,000 there were 111 who survived.(A-11)

PICO DE ORIZABA: (volcano) *Stratovolcano* 18,410 feet (5,610 m.) plateau of Mexico. It is the highest peak In Mexico. It is the second most prominent volcano in the world, only second to Kilimanjaro and can be seen by ships in the Gulf of Mexico. The last eruption was in 1687. The mountain is part of a National



Park and “Internet” indicates a number of tours that are available as well as skiing and canoeing. *Pico de Orizaba – Wikipedia*)

PICO DE TIEDE: (volcano) *Stratovolcano*, height, 12,180 feet (3,712 m). On Tenerife, one of the Canary Islands. It lies within the 10-mile wide caldera of an earlier volcano. AOL Search, research for mountain Pico de Tiede)

PIKES PEAK: 14,110 feet (4,301 m.) front range in Colorado, U.S.A. It is the most famous of the Rocky Mountains. It has a prominent position in the Front Range of the Rocky Mountains, about 10 miles (16 km.) west of Colorado Springs. It has several ways to reach the visitors’ center at the top. The most famous is the road. There is also a cog railway that operates the year round, weather permitting. The mountain is mainly composed of pink granite. *Pikes Peak – Wikipedia*)

PINATUBO, MOUNT: (volcano) *Stratovolcano*, 5,065 feet (1,543 m.) (Luzon, Philippines. ) It is North of Manila. June 15, 1991. It was the first well-documented eruption, and its first eruption in over 600 years. The amount of ash from the volcano was sufficient to affect the world climate. (1)

Scientists recorded the development of a caldera, prior to eruption on record. Ample warnings saved many thousands of lives. The output of ash caused worldwide cooling and spectacular sunsets for a year. Heavy rains, mixed with ash, have caused mudslides and loss of life since that date. “Typhoon Yumya made the climax of Pinatubo particularly unpleasant. It drenched the ash, causing many roofs to collapse.” A great number of public buildings and hospitals had their roofs collapse.(A-12)

PISSIS, MOUNT: (volcano) *Stratovolcano*, elevation, 22,257 feet (6,793 m.) in the Argentina, Andes. It is the 2nd highest mountain in the Americas. Due to its location in the Atacama Desert, it only has snow on the peak in the winter. It is an extinct volcano in the desert in La Rioja Province, a remote area. *Mount Pissis – Wikipedia*)

PITON DE LA FOURNAISE: (volcano) *Shield Volcano* height, 8,650 feet. On the French island of Reunion in the Indian Ocean east of Madagascar. Last eruption was in 2003. It is one of the biggest and most active volcanoes in the world. *Extreme temporal - - Piton de la Fournaise, Internet*)

POPACATEPETL: (volcano) *Strata volcano* 17,887 feet (5,452 m) and 171.2 miles across. (Mexico)  
“Aztec name for ‘Smoking Mountain’” (a)  
It is N. America’s second highest volcano with a symmetrical shape, summit glaciers, and frequent eruptions.

POARANA OKATEA (volcano) *fissure vent*, The height is up to 3,000 feet (914 m.). The location is across southern Brazil and Paraguay. *Poarana Okatea –*

*Wikipedia)*

**RABAU CALDERA:** (volcano) *Rhyolite Caldera Complex*. On the northeast end of the island of New Britain, Palau. The caldera is 5 x 9 mile (8 x 14 km.) The city of Rabaul is situated inside the caldera bowl. The highest of its multiple peaks is 2,255 feet (688m. elevation A sub volcano, Vulcan, erupted in 1984. It may be a *Rhyolite Caldera Complex*. The eruption of 1994 destroyed the city of Rabaul but evacuation saved all but 5 people. (*Rabaul Caldera – Wikipedia*)

**RAINIER, MOUNT:** (volcano) *Strata Volcano* 14,4410 feet. (4,392 m.) (Washington, U.S.A) SE of Seattle. It has 25 glaciers covering about 36 sq. miles(93 sq km) of glacier, dating back 35,000 years. It is classified as dormant. An eruption would threaten a million people in the valleys to the West. Gasses and fumes still rise from its cone. (m)

It is the remnants of a much larger structure from about 5,700 years ago and produced a great mud flow (lahan) that reached Puget Sound, 70 miles (110 km) to the Northwest. (*Rabaul Caldera, Papua New Guinea – Eruptive History*)

**RASTAJAN** 16,158 feet (4,925 m.) (Ethiopia)

**ROSA-DUFOUR, MOUNT:** (Mount Rosa) Swiss Alps. 1,5209 feet (4,637 m.) The mountain is renowned for 360 degree view from its peak, safely reached by cable car from Alagna. The climb is not considered difficult. . (*Piedmont Enzioni, Mount Rosa-Dufour, Google*)

**ROTORUA:** See Taupo. *Rhyolite Caldera Complex*(super volcano) (New Zealand, North Island) There are many active hot springs and dangerous areas to walk. Much of the heat is used in homes for heating. The area should be included in tours. The park has an excellent museum of early Moro culture as well as native fauna. (*AOL Search, research for mountains/Rotorua*)

**RUAPEHU:** (volcano) *Stratovolcano* height, 9,178 feet (2,797 m.), located 25 miles (54 km.) southwest of Lake Taupo, and in the Taupo volcanic zone. It is the highest mountain on the north island and has three peaks. The caldera is located between the peaks and fills with water between major eruptions. Dams formed by eruptions plug the outlet of the lake. When they break, major lahars occur. Major eruptions occurred in 1895, 1945, and 1995.on the North Island of New Zealand. (*Mount Ruapehu – Wikipedia*)

**RUENZORI:** 16,794 feet (5,119 m.) (Congo-Uganda)

**ST. ELIAS, MOUNT:** 18,009 feet (5,489 m.) It is on the border between the Yukon and Alaska in the St. Elias mountains. It is second in height to Mount McKinley in the U.S. and second to Mt. Logan in Canada. Both Canada and the U.S. include it in National Parks. It is over 11,000 feet (3,400 m.) above its base. (*Mount St. Elias – Wikipedia*)

ST. HELENS, MOUNT (volcano), *Stratovolcano* 8,364 feet (2,540 m.) (Washington, U.S.A.) Its last eruption was in 1991. On 27 March, 1980, its first eruption in 123 years, reduced the height by 1,000 feet (300 m). It discharged about one cubic mile (2.59 cu km) of ash and mountain. In spite of early warnings, it caused 57 deaths. Its last previous eruption was in 1857. Explosions from the peak flattened millions of trees.

Floods and mud slides (lahars) caused damage and loss of life. Ash destroyed crops and wildlife over a large area. (n)

There were a number of smaller eruptions during the next decade, building a new cone. (A-13)

The eruption of St Helens has prompted volcanologists to closely examine the other volcanoes in the Northwest, including Mt. Rainier, Mt. Adams, Mt. Hood and Mt. Shasta. Most of these mountains are in areas heavily populated and vulnerable to mud slides (lahars) and volcanic effluvia.

*Mount St Helen – Wikipedia)*

SANTORINI (see Thira) In the Web, use Santorini

SHASTA, MOUNT (volcano) *Strata volcano*, 14,162 feet (4,317 m.) (California, U.S.A.) It is the Southernmost of the great Cascade volcanoes. It rises about 10,000 feet (3,000 m) above the surrounding low mountains. A small cone is located about 2,500 feet (750 m) below the summit. It is NW of Mt. Lassen and in Northern California. (o)

“It is famous for its twin peaks.” (a)

Mt. Shasta has 4 cones, each formed by a major eruption in the last 500,000 years. The last cone was formed in an eruption about 8,000 years ago. The last known eruption was in 1786. Eruptions have occurred about every 600 years. Fumaroles on Shasta indicate it is still alive. (*Mount Shasta – Wikipedia)*

SIBERIAN TRAPS: (volcano) *Fissure* (Siberia) height is up to 1,650 feet (500 m), central Siberia. Last eruption was about 250,000 years ago. The major flows are dated at about 60,000,000 years ago. The lava flow was accompanied by great amounts of toxic gases that may have involved the extinction of species. Lava flows covered more than 115,000 square miles. (300,00 sq km). (*Ultimate Volcanoes – Volcanoes, Whyfiles.org)*

SIERRA LA PRIMAVERA: *Rhyolite Caldera Complex* Mexico, near Guadalajara. The last eruption was in the Pleistocene era, about 100,000 years ago. At that time, about 20 cu km or 8 cubic miles of material, forming a caldera about 5 miles (8 km) wide. Subsequently the caldera filled with water. There have been a number of lava flows since that time, partially filling the lake. The last lava flow was about 30,000 years before the present time. There are steam vents and hot springs in the area. *Sierra la Primavera, Global Volcanic Program) WWW*

SOUFRIERE HILLS: (volcano) *stratovolcano* height 3,002 feet (915 m). The southern

half of the island of Montserrat. It is an active volcano with complex structure and a number of vents. The volcano was dormant for 3 centuries until 1995. Pyroclastic flows destroyed the capital city, Montserrat. About 2/3 of the population of the island have been evacuated. The volcano has continued to erupt through 2007. *Soufriere Hills - Wikipedia*

STROMBOLI (Volcano) *Stratovolcano*, On one of the volcanic islands NE of Sicily, Italy. It is unique because it normally erupts every 20 minutes. If the span is longer, the eruption is greater. It has been putting on a show for centuries. (A-14)

SURTSEY: (volcano) 588 feet (179 m.) North Atlantic. An underwater volcano began forming a new island in 1963, off the coast of Iceland. (p)

TAAL: (volcano) *Rhyolite Caldera Complex* height, 1,312 feet (405 m). (Philippines) South of Pinatuba on the west coast of the Island of Luzon, Philippines. Its caldera is 12 miles (19 km) wide and contains Lake Taal. The volcano has erupted at least 12 times in recorded history, sometimes very violently. (*Lake Taupo – Wikipedia*)

TAMBORA, MOUNT: volcano) *Rhyolite Caldera Complex; Stratovolcano* (super volcano) 9,350 feet (2,850 m.) (Sumbawa, Indonesia.) The last eruption was in 1967. On April, 1815, eruption of 170 billion ton of debris. It was a 13,000 ft (9,100 m) high volcano, and blew 36 cubic miles of its top into the air, releasing the energy of about 6 million times more energy than an atom bomb. It killed about 92,000 people. The combination of volcanic ash and sulfur dioxide cause worldwide cooling that created the year (1816) without a summer, resulting in a million deaths of starvation and associated diseases. (p)

TAUPO: *Rhyolite Caldera Complex* New Zealand, North Island. Lake Taupo is in the caldera of Taupo. The lake is surrounded by resorts. It is considered a part of the “Ring of Fire” that surrounds the Pacific Tectonic Plate. The caldera was formed about 27,000 years ago when the Volcano last exploded. The last explosion was in 180 A.D., when more than 33 Billion tons of pumice and ash more than 55 kilometers (30 miles) high into the air. It took over 2 years for the air to clear.

It has erupted 28 times in the last 27000 years. The eruption in 27 A.D. blew 34 cubic miles (100 cubic km.) of material into the sky. It is considered to be one of the most violent eruptions in the last 5,000 years. (*Lake Taupo - Wikipedia*)

THIRA: *Rhyolite Caldera Complex*(super volcano) 1,850 feet (564 m.) Eastern Mediterranean. The last eruption was in 1850.

“Eruption in about 1,500 B.C. created a tsunami that may have destroyed Minoan civilization on Crete, legend of lost continent of Atlantis.” (p)

Many volcanologists believe the eruption was large enough to have created a climate change. It killed all the inhabitants on Santorini and buried it in up to 190 feet (60 meters) of ash. *Santorini - Wikipedia*

The volcano is a combination of 4 cones, the highest is 1,850 feet (565 m). The major cone is submerged. Minor eruptions have occurred, the last in 1990.

TOBA (volcano) *Rhyolite Caldera Complex* (super volcano) elevation 7,800 feet (2,380 m) (Indonesia, Sumatra). Its caldera is a lake. (See Lakes, Toba) The lake is surrounded by mountains that were formed by materials from the caldera. (*Toba - Wikipedia*)

Toba Catastrophe Theory: “70,000 to 75,000 years ago a super volcano event at Lake Toba, on Sumatra, reduced the World’s human population to 10,000 or even a mere 1,000 breeding pairs, creating a bottleneck in human evolution.” (*Toba Catastrophe Theory – Wikipedia*)

It is theorized that this event caused a 9 degree F (5 degree C) drop for several years and may have triggered an ice age, lasting up to 100 years. Virtually all branches of humanity except for Neanderthal and modern man were lost. Genetic evidence supports this theory.

(*Toba Catastrophe Theory – Wikipedia*)

An excellent source for Toba’s part in history is found in Ch. 5 “Human Evolution” A copy of this chapter is found on the internet *AOL Search, research mountains/Toba*.

VESUVIUS (volcano), *Complex Volcano* 4,190 feet (1,277 m.) (Southern Italy).

In A.D. 79, an eruption buried Herculaneum and Pompeii with nearly total loss of life from ash & poison gas. The cities were buried under twenty or more feet (6 m) of ash. (p)

“only active volcano on the mainland of Europe.” (A-15)a

There are a number of volcanoes in Southern Italy that are dormant.

Vesuvius is within the caldera of an older volcano, formed about 7,000 years ago. Its circumference is about 45 miles (72 km). About 3 million people live within its eruption range. *Mount Vesuvius – Wikipedia*)

VULCANO: (volcano) *Stratovolcano*. The height is 1,640 feet (324 m.). (Italy)

It is the southernmost of the Aeolian Islands off the coast of Sicily. The island is 9 sq. miles (24 sq. km.) with a small village. The last major eruption was in 1888 and lasted 2 years. According to Roman legend it was the home of Vulcan, the god of fire. (*Vulcano – Wikipedia*)

WEST EIFEL FIELD: (volcano), *Cinder Cones*. Height is 1,965 feet (598 m). It is in the Rhine valley S. of the city of Cologne. Last activity was 7,000-11,000 years ago. The West Eifel Field is associated with the Rhine Rift.

WHITNEY, MOUNT, (granite) 14,495 feet (4,418 m.) (California, U.S.A.)

“Highest mountain in California.” (a)

Mount Whitney is part of the crest of the Sierra Nevada Range, and is the highest mountain in the contiguous United States. It rises 10,081 feet (3,073 m.) above the Owens valley. Water flows east to the Great Basin and west to the Pacific ocean. (*Mount Whitney – Wikipedia*)

YELLOWSTONE (super volcano.) *Rhyolite Caldera Complex* (Wyoming, U.S.A.)

It is the largest volcano in world. With a caldera of melted rock at (3,660 degrees F.) 2,000 degrees C. and about 50 by 30 miles (48 by 80 km) in size. The last eruption was 640,000 years ago. The area of destruction was about 1 million square miles (3 million sq km) and discharged about 675 cu mile (2,800 cu km) of material..

Major eruptions occur between 700 and 800 thousand years apart The record of eruptions goes back 21,000,000 years as the North American tectonic plate has moved over the hot spot. Each explosive eruption has left its mark as a plateau. These eruptions are like a string of beads. The earliest identifiable one is along the Utah-Oregon border. The North American tectonic plate is moving to the West. about 4 inches (10 cm) a year. *Yellowstone Caldera – Wikipedia*  
(*Yellowstone Volcano, is the beast building to a Violent Tantrum? – National Geographic, Internet*)

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- (a) World Book, 1993, Volume 13, “Mountains pp 891-ff
  - (b) Ibid. p 882..
  - (c) Ibid, p 883.
  - (d) Ibid, p 883
  - (e) Ibid., P 883.
  - (f) Ibid, pp 883-4
  - (g) Ibid, p 884.
  - (h) Ibid, p 885.
  - (i) Ibid, p 885.
  - (j) Ibid, p 885.
  - (k) Ibid, p 886
  - (l) Ibid, p 886
  - (m) Ibid, pp 886-7
  - (n) Ibid, p 888
  - (o) Ibid, p 888
  - (p) Ibid, Volume 20, “Volcanoes” pp 438-443.
  - (q) Decker,; Robert & Barbara, “Volcanoes”, p 211 plate 22.
  - (r) Ibid. p. 211 plate 18.
  - (s) Ibid, p 67.
  - (A1) “Vulcan’s Fury” Alwyn Smith, 1999, Worldprint, Hong Kong , Chapter 9,

- pp 123-132.
- (A-2) Ibid. Chapter 5, pp 57-76.
  - (A-3) Ibid, Chapter 10, pp 135-156
  - (A-4) Ibid, Chapter 15, pp 245-254.
  - (A-5) Ibid, Chapter 8, pp 105-122.
  - (A-6) Ibid, Chapter 7, pp 87-104
  - (A-7) Ibid, Chapter 4, pp 43-56
  - (A-8) Ibid, Chapter 14, pp 227-244.
  - (A-9) Ibid, Chapter 6, pp77-86
  - (A-10) Ibid, Chapter 12, pp 191-210.
  - (A-11) Ibid, Chapter 11, pp 157-190.
  - (A-12) Ibid, Chapter 16, pp 225-274
  - (A-13) Ibid, Chapter 13, pp 211-226.
  - (A-14) Ibid, Chapter 2, pp 13-20.
  - (A-15) Ibid, Chapter 3, pp 21-42.

## OCEANS AND SEAS

A number of different people were interviewed as to how they would like this category to be arranged. The consensus was that the seas were more a part of the ocean than they were separate entities. The only exception to this was the Mediterranean Sea, which has an identity of its own. In response to their opinions this category on Oceans is divided into 5 sections; Atlantic Ocean, Arctic Ocean, Indian ocean, Pacific, & Southern Oceans.

*Light penetration:* by wave depth:

Red	15 feet	4.6 m
Orange	16 feet	4.9 m
Yellow	25 feet	7.6 m
Green	40 feet	12.2 m
Blue	60 feet	18.3 m
Violet	90 feet	27.4 m

*Pressure:* At sea level, atmospheric pressure is about 14.5 pounds (6.58 kg) per square inch. One (1) “bar” is 14.5 pounds (6.58 kg) of pressure. Pressure increases about 1 bar every 33 feet (10.1 m) in depth. At 330 feet (10.1 m) pressure would be about 10 bar or 145 pounds (65.8 kg) per square inch .

*Note:* 14.5 pounds per sq inch would be .9 kg per sq cm

*Salinity* is about 35 ppf or 3.5%. It will vary from area to area because of the flowing of river water or of melting icebergs. The ocean water contains many salts, elements, and impurities in small amounts. Fresh water tends to stay on top and mixes slowly

*Sound:* The sped of sound varies with depth. At the surface, sound travels about 5,000 feet (1,500 m) per second. This speed is increased with depth to about 3,000 feet and decreased somewhat by lower water temperature.

*Temperature:* Although there is great variation in the temperature of surface water, the temperature drops to about 46-50 F (7.2 degrees C) in the area between 1,000-3,500 feet (330-1,060 m). Below that depth, the temperature gradually drops to a temperature of 35.6 F. (2.95 degrees C) worldwide.

**The above data can be found in “Earth” by Smithsonian, pp 384-5**



## GEOGRAPHIC DIVISIONS

### Atlantic Basin

- Baltic Sea
  - Gulf of Bothnia
  - Gulf of Finland
  - Gulf of Riga
- Bay of Biscay
- Bay of Fundy
- Black Sea
- Caribbean Sea
- Gulf of Mexico
- Gulf of St. Lawrence
- Hudson Bay
- Mediterranean Sea
  - Adriatic Sea
  - Aegean Sea
  - Gulf of Sidra
  - Ionian Sea
  - Sea of Greece
- North Sea
- Norwegian Sea
- Sargasso Sea

### Arctic Ocean

- Baffin Bay
- Barents Sea
- Chukehe Sea
- East Siberian Sea
- Greenland Sea
- Kara Sea
- Lapteve Sea
- White Sea

### Indian Ocean

- Arabian Sea
- Bay of Bengal
- Mozambique Channel
- Persian Gulf
- Red Sea

### Pacific Ocean

- Banda Sea
- Bering Sea
- East China Sea
- Coral Sea
- Gulf of Alaska
- Gulf of California
- Sea of Japan

Sea of Okhotsk  
South China Sea  
Sulu Sea  
Tasman Sea  
Yellow Sea

Southern Ocean (areas around Antarctica and actually part of Atlantic, Indian and Pacific Oceans)

Ross Sea  
Scotia Sea  
Wedell Sea

## ARCTIC OCEAN

(*Arctic Ocean – Wikipedia*)

*Size:* It covers about 5,400,000 square miles (14,0567,000 sq. km.) slightly less than 1.5 times the size of the United States. The ocean is broken up by many islands and bays. Its greatest length is about 2,650 miles (4,267 km.) .Its average depth is about 3,950 feet (1,200 m.) and its greatest depth is 17,500 feet (4,600 n.).

*Climate:* Temperatures range from about –28F (-33 C) in January to about 29 F (-2 C) in June. The Arctic is cloaked in darkness from November to February. Much of the Arctic is covered by a permanent ice pack.

*Geography:* It is relatively isolated except for channels between the continents and either side of Greenland and east of Iceland. The Arctic Ocean is broken up by a great number of islands, some of them quite large. The Arctic Ocean includes Baffin Bay, Barents Sea, Beaufort Sea, Chukchi Sea, East Siberian Sea, Greenland Sea, Hudson Bay, Hudson Strait, Kara Sea, Laptev Sea, White Sea, and other tributaries and bodies of water.

It is connected to the Pacific Ocean by the Bering Strait, and to the Atlantic Ocean through the Greenland Sea and the Labrador Sea.

*Ocean Currents:* Water flows into the Arctic Ocean through the Bering Straits and through the straits East of Iceland and into the Arctic through the Greenland strait and the Davis Strait.

*Ocean Life:* Phytoplankton thrives in the water and is a basic food for many fish and whales. (a)

### *Coastal Areas, Bays & Seas:*

**Baffin Bay:** 266,000 sq. miles. (676,000 sq km) It is Southwest of northern Greenland and northwest of Baffin Island. It is separated from the Arctic basin by Ellesmere Island and by parts of the Canadian Archipelago. The Bay is largely free of ice from August to October

**Barents Sea:** 542,000 sq. miles (1,400,000 sq km). North of Norway and Eastern Russia> The maximum depth is 2,500 feet (760 m)..

The Barents Sea is unique in that a major part of it is ice-free the year round. It covers a part of the continental shelf cut by trenches.

**Beaufort Sea:** Area, 184,000 sq. miles (477,000 sq km).

It is North of Alaska and Northwest of the Canadian border.

Its maximum depth, 15,350 feet (4,680 m)

It has a shallow coastal area and a deep offshore area. The Mackenzie River deposits billions of tons of fresh water and about 15 million ton of sediment in the sea each year.

**Chukchi Sea:** Area, 225,000 sq miles (583,000 sq km))

It lies to the north of eastern Siberia and northwest of Alaska. The maximum Depth is 360 feet (100 m). Water flows in from the Bering Straits. It is totally iced over from December to May.

East Siberian Sea: 361,000 sq. miles 961,000 sq km).

It is bounded by the New Iberian Islands in the West and Wangel Island in the east.. Maximum depth, 510 feet (155 m)

It is the shallowest of the Arctic seas with an average depth of 35-65 feet (10-20 m)in the west and 100-135 feet (30-40 m)in the east. Up to 2.6 million gallons (98,500 cu m) of water pour into the sea in spring. It is navigable only in August and September because of ice.

Greenland Sea: Area, 465,000 sq. miles (1,200,000 sq km). It is bounded by the Arctic Basin to the North, Swalbard to the northwest and Iceland to the South.

The maximum depth is 16,000 feet (4,700 m).

Water flows in from the Arctic Basin and the Norwegian Sea. It is an important body of water for the exchange of waters of the various warm and cold streams. It is in this area that too much fresh water could seriously affect the northward flow of the Gulf Stream.

Hudson Bay: Area, 316,000 sq. miles (818,000 sq km.) and its greatest depth is 900 feet (280 m.). It is a large shallow basin of water, averaging 422 feet (128 m.). It occupies a low area of the Canadian Shield. Surface water is relatively salt-free because a deep inflow of water comes from the north but inflow from a large fresh water drainage area.

Kara Sea 340, 000 sq. mile (881,000 sq km)s,  
The maximum depth is 20,0035 feet (6,107 m).

It is bordering the islands of Novaya Zemlya in the west and Severnaya Zemlya in the east. Much of the sea is very shallow, being over the continental shelf, cut by two deep trenches.. Large amounts of fresh water pours into the Kara during the summer from Siberian rivers.

Laptev Sea 276,000 sq. miles (715,000 sq km).

It is bounded by Severnaya Zemlya in the west and the New Siberian Islands in the east. Maximum depth is 9,775 feet (22979 m)

Almost all of the sea is covered by permanent ice-pack. It is called the cold pack the Arctic.

White Sea 35,000 sq. miles 10,000 sq km)

It forms a link between the Barents Sea and Northern Europe.

The maximum depth is 1,115 340 m)feet .

It is almost completely landlocked with an average depth of 200 feet (60 m). It is connected to the Barents Sea by a narrow strip and to the Baltic by a manmade canal. The sea is navigable 12 months of the year.

*Reference for Arctic depended heavily on "Earth" by Smithsonian, pp398-401.*

## ATLANTIC OCEAN

(Atlantic Ocean – Wikipedia)

*General:* Geologically it covers parts of the African, South American, North American and Eurasian tectonic plates and nearly all the Caribbean plate. Geographers now separate the Southern Ocean from the Atlantic although it is an artificial division. The Antarctic plate underlies parts of the Atlantic, Pacific, and Indian Oceans.

*Size:* 29 million square miles (75 million sq km)). Maximum depth is 29,230 feet (8,910 m), average depth is 12,880 feet (3,930 m). It is over 3,000 miles (4,900 km) wide and reaches from the Arctic to Antarctic circles. These figures do not include the Atlantic portion of the Southern Ocean.

*Climate* The climate ranges are from tropical to sub-polar. There is shelf ice along Antarctica and Hudson Bay freezes during winter. Many storms begin near Africa and move westward to the American continent, some of which are classified as major hurricanes. The North Atlantic is especially known for winter storms and floating icebergs calved on the Greenland Ice fields..

*Geography:* The Atlantic Ocean is a growing ocean as the various tectonic plates move apart by actions of the inner earth. The Atlantic is growing by several inches a year. The ocean bed tapers from the continental shelf off each continent. The Atlantic Ocean lies on the North America, South America, African, and Eurasian tectonic plates. As these plates move apart, the Atlantic Ocean grows larger.

*Ocean Currents:* The waters of the Atlantic are a major factor in climate because of the effect of its many currents. The Gulf Stream is the best known, as it flows from the warm waters of the Caribbean to the West coast of Europe and thence along the shores of Norway. Deep ocean currents carry water back to the Caribbean.

An upwelling of cold ocean water from the Arctic Occurs surfaces off the coast of West Africa. West winds blowing over this cold water pick up very little moisture. These winds heat up as they cross the Sahara and leave little rain.

In the South Atlantic a great swirl of water flows in a counter-clockwise direction, with warm water flowing West and South along the Argentina and Brazil coast, cooling as it flows East along the boundary of the Southern Ocean. By the time it flows along the West coast of Africa it is chill. Winds blowing across this cold current pick up very little moisture and as they blow across the Kalahari and Namib Deserts they drop little moisture. .

*Ocean Life:* The Atlantic is known for great schools of fish, Cod is a staple of life for Portugal and fish is the main source of protein for Nations on the West Africa coast.

*Coastal Area, Bays & Seas:*

**Baltic Sea:** Area is 149,000 sq. miles (390,000 sq. km.). Its maximum depth is 1,475 feet (450 m.). It is located between Sweden and Finland. The Baltic States and Poland are on the South shore. Winters are long and cold and summers are cool. The water is far less salty than the ocean because of drainage from much of northern Europe.

**Gulf of Bothnia:** comprises the north part of the Baltic.

**Gulf of Finland:** is along the coast of Finland and has a great number of islands along the coast,

**Gulf of Riga:** is an area along the north coast of Poland, Lithuania, Estonia, and Latvia.

**Bay of Biscay:** Area, 86,000 sq. miles (223,000 sq. km.). Its maximum depth is 13,500 feet (4,115 m.). It is bounded on the east by France and on the south by Spain. The bay is partly on the continental shelf and partly an abysmal plain. Shores range from high cliffs to marshy land. Navigation is difficult because of strong western winds and many islands on the continental shelf. Fishing and oyster culture are economically important.

**Bay of Fundy:** Area, 3,000 sq. miles (7,800 sq. km.). Its maximum depth is 1,200 feet (366 m.). It is located between the Canadian provinces of Nova Scotia and New Brunswick. Its tides can be as great as 70 feet (21 m.) between low and high tide.

**Black Sea:** Area, 165,000 sq. miles (427,000 sq. km.). It is located between the western part of Asia and the extreme southeast part of Europe. The Danube, Dniester, Dnieper, and Sea of Azov flow into it. Its outflow is into the Mediterranean through the Dardanelles and the Bosphorus.

It is important for commerce and fishing but suffers from pollution from the rivers, especially the Danube.

**Caribbean Sea:** Area, 1.1 million sq. miles (2.85 million sq. km.). It is east of Central America, north of South America and south of the Gulf of Mexico. Its maximum depth is 25,215 feet (7,686 m.).

The Caribbean is best known for the great number of islands, both coral and volcanic, and the great number of resort areas. Its warm waters are the source of the Gulf Stream, so important for moderate European climates. There is an abundance of fish and shipping lanes cross the Caribbean to the Panama Canal.

**Gulf of Mexico:** Area, 600,000 sq. miles (1,550,000 sq. km.). Mexico is on the west, the U.S. is on the north and east.

The greatest depth is 17,000 feet (5,200 m.).

The continental shelf is rich in oil and gas. Many of the coast areas are swampy. The major fresh water to this nearly landlocked gulf is the Mississippi River. The gulf is rich in many types of fish and mollusks as well as petroleum.

The gulf is subject to many hurricanes and water spouts. The warm water readily evaporates and warm moist winds feed the storms that often devastate the areas west of the Mississippi River.

**Gulf of St. Lawrence:** Area, 60,000 sq. miles (155,000 sq. km.)

The maximum depth is 7,550 feet (2,325 m.).

It extends from the mouth of the St. Lawrence River in eastern Canada to western Newfoundland. It is part of the St. Lawrence Seaway extending through the Great lakes.

About 3.5 million gallons (11 acre feet or 132,000 cu m)) of fresh water is discharged into the Bay each second. Tides reach Quebec City, on the river. .

**Mediterranean Sea:** Area, 970,000 sq. miles (2,51,000 sq km.).

Its maximum depth is 16,000 feet (4,930 sq km.).

It is located in a depression between the Eurasian and African Continents. .

For several million years the sea was separated from the Atlantic Ocean. A rise in the water level of the oceans after the ice ages allowed the Atlantic to overflow the barrier at the Strait of Gibraltar. The Straits of Gibraltar are now about eight miles wide and 1,025 feet (315 m) deep. The sea is a vital commercial and fishing area and is considered the area of the birth of Western civilization.

**Adriatic Sea:** Area is about 60,000 sq. miles (155,000 sq km.) with average width of 100 miles (35 km.), and length of 480 miles (146 km.) long. The sea has many resorts on both coasts. The height of the water can vary significantly at Venice depending on strength and direction of the wind.

**Aegean Sea:** The area is about 69,000 sq. miles (179,000 sq km.). It is 400 miles (645 km.) long, and about 200 miles (322 km) wide. It is between Greece and Turkey with many islands. It is the route between the Black Sea and the Mediterranean Sea.

**Gulf of Sidra:** On the coast of Libya. The bay is an open bay about 200 miles (320 km) across and about 50 miles (80 km.) deep

**Ionian Sea:** Its area is about 60,000 sq. m (155,000 sq km) Its width is up to 420 miles (680 km) and a maximum depth of 16,300 feet (5,000 m). It separates Italy and Sicily from Greece and Albania.

**Sea of Greece:** Area is between 5-10 thousand sq. miles (12.5-25 thousand km sq). It is about 150 by 150 miles (240 by 240 km) and separates Greece from Crete.

**North Sea:** Area is 200,000 sq . miles (520,000 sq. km.).

Its maximum depth is 2,500 feet (776 m.)

It is located between Northwestern Europe and the east coast of Great Britain. .

The North Sea is especially known for productive fisheries, abundant petroleum deposits and fierce storms.

**Norwegian Sea:** 554,000 sq. miles (1,435,000 sq km.). It is between Norway and the North Sea and bordered by the Greenland Sea.

Its maximum depth is 13,000 feet (3,950 m.).

It is the farthest north of the navigable seas of the Atlantic; kept free of ice y warm currents from the Gulf Stream to the Norway Stream. Strong tides along the Norwegian coast create dangerous whirlpools.

Sargasso Sea: Area is about 2 million sq. miles 5 million sq km.).

Its maximum depth is 23,000 feet (7,000 m.).

It is located in the North Atlantic Ocean South of Bermuda. .

The Sargasso Sea is a large area of the N. Atlantic that circulates clockwise; caused by three currents that flow along its edge. The water in the center of the circle is about 3 feet higher than the edge.



## INDIAN OCEAN

(*Indian Ocean – Wikipedia*)

*General:* The Indian Ocean is the youngest ocean and with the most complex floor.

*Size:* Area is about 26.5 million sq. miles (67,000,000 sq km.), Average depth is 12,700 feet (3,890 m.) and maximum depth is 25,812 feet (7,855 m.). North- South distance is 6,200 miles (10,050 km.) and east-west distance is 6,100 miles (9,890 km.).

*Climate:* North of the equator the ocean is affected by cyclones and monsoons that move north over the eastern Ocean on to India and the Malay Peninsula from May until October. November through March winds are from the northeast. The monsoons do not extend west of the Indus River.

*Geography* Africa is to the west, Asia is to the north, with the Malay Peninsula and Indonesia to the east. Australia is in southeast and the Southern Ocean is in the South. The Indian Ocean is open to the Atlantic south of Africa and open to the Pacific around the islands of Indonesia and Australia.

The Indian Ocean rests on the tectonic plates of Africa, Asia, Indian subcontinent and the Australian plates. They are moving apart so the Indian Ocean is expanding. The ocean floor has ridges where the tectonic plates contact each other. There are a number of island nations including Sri lank and Madagascar. The Indian Ocean averages a greater depth than any other ocean.

*Ocean Currents* Two major currents flow west along the equator. The north one flows north and east, completing the circle west of Indonesia. The second one turns south and splits. A portion flows along the African coast and to the Atlantic. The rest flows back near the Southern Sea and turns north past Australia. There is an upwelling of cold water just west of Australia, causing dry winds to flow over the continent.

:

*Ocean Life:* The Indian Ocean is the warmest of the oceans and salinity is the highest. Sea life tends to be tropical by nature. Deep-water currents from the Atlantic and the Southern Ocean bring rich nutrients to Madagascar and west Australia increasing the abundance of sea life.

### *Coastal Areas, Bays & Seas:*

Arabian Sea: The area is 1.5 million sq. miles (3,880,000 sq km).

Its maximum depth is 19,030 feet (5,800 m)

It is to the east of the Arabian Peninsula and to the southwest of the Indian sub continent. The Gulf of Aden connects it to the Red Sea and the Gulf of Oman connects it to the Persian Gulf.

Bay of Bengal: Area is 1,1 million sq. miles (2,850,000 sq km).

Its maximum depth is 15,100 feet (4,600 m).

It is located to the east of the Indian Peninsula and to the west of Burma. It is the northeast part of the Indian Ocean. Its smaller eastern part, the Andaman Sea is separated from the rest by 2 island groups, the Andaman and the Nicoban.

Much of the Monsoon water and tropical storms are magnified by the warm waters of the Bay of Bengal.

Mozambique Channel: Area is 386,000 sq. miles (1,000,000 sq km).

Its maximum depth is 9,800 feet (2,990 m).

It separates Mozambique on the west from Madagascar on the East

Persian Gulf: Area, 95,000 sq. miles (246,000 sq km),

Its maximum depth is 360 feet 1,100 m).

It forms an inlet from the Arabian Sea with Iran to the east and the Arabian Peninsula to the west. Almost all the oil and natural gas in the area is transported by way of the Persian Gulf

Red Sea: Area, 175,000 sq miles (453,000 sq km).

Its maximum depth 9,975 feet. (3,040 m)

Its location is between North Africa and the Arabian Peninsula.

The Red Sea is the warmest of the seas. Because of rapid evaporation, the sea is highly saline. Marine animal life thrives in this water. The Red Sea is an extension of the African Rift Valley. Activity of scuba divers has caused considerable damaged to coral reefs.

## PACIFIC OCEAN (Pacific Ocean – Wikipedia)

*General* The Pacific covers about 1/3 of the globe's area and half of its oceans. It is significantly larger than earth's landmass. It covers about 46% of earth's water surface and about 32% of the total surface of the earth.

*Size:* Total area is 65.3 million sq. miles (169.27 million sq. km.). The distance between Indonesia and Colombia is 12,300 miles (19,800 km.) and the distance between the Bering Sea and Antarctica's Ross Sea is 9,600 miles (15,500 km.) Its average depth is 14,000 feet (4,280 m.) and its greatest depth in the Marianas Trench is 35,797 feet (10,911 m.)

*Climates:* Most of the Pacific is unaffected by land masses. Trade winds are relatively consistent. Fierce winter storms are common in the far North along the Bering Sea. Much of the Pacific is affected by monsoons as southerly or northerly winds pick up moisture from the warm tropical waters. Typhoons are not uncommon and are as violent as the Atlantic Hurricanes. A phenomenon called the *El Nino* is a body of warm water that is blown eastward to the area of South America. It can affect weather conditions over much of the Earth. Its counterpart the *La Nina*, a very large body of coldwater, often follows the El Nino.

*Geography:* The Pacific rim is known for its "Ring of Fire", made up of a great number of volcanoes including several *Super Volcanoes*. There are many peninsulas and seas along the western border of the Pacific. The Pacific contains about 25,000 islands, the majority of which are found south of the equator. The Pacific is shrinking as the Atlantic grows larger.

An Andistic line circumvents the igneous bowl of the Pacific from the semi-igneous rim. The so-called *continental islands* lie outside this line. They include New Zealand, New Guinea, The Philippines, and Japan. Nearly all the other islands lie between the 30<sup>th</sup> parallel south and the 30<sup>th</sup> parallel north. The islands of the Pacific are of four types, *continental, high islands, coral reefs and coral uplift platforms*. High Islands are volcanic origin and include the Hawaiian Islands,

*Ocean Currents:* A counter-clockwise pattern of surface currents forms in the southern Pacific and a clockwise pattern forms in the Atlantic. Familiar among them is the Japan Current that flows north along Japan, giving it a milder temperature. Exceptions to these currents are currents developed in response to long-term wind patterns. An example of this is current that brings El Nino to the South American area from Indonesia. And the Western Pacific. This is often followed by *La Nina* an upwelling of cold water. El Nino is discussed in section on weather.

*Ocean Life* Great schools of fish are important in the northern Pacific, especially the area south and north of the Aleutians. Coral is a building block in the formation of thousands of islands in the western Pacific.. Over-fishing by trawlers that use nets that

indiscriminately trap many species of fish besides the one wanted. A significant decline in many species of fish has been a result.

#### *Coastal Areas, Bays & Seas*

**Banda Sea:** Area is 180,000 sq. miles (466,000 sq km), its greatest depth is 24,400 feet (7,440 m). It is located southeast of Sulawesi and west of Maluku (the Spice Islands).

**Bering Sea:** Area, 890,000 sq. miles (2,305,000 sq km). Its maximum depth is 16,500 feet (5,030 m). It is located between Alaska and the northeastern part of the Asian landmass. It is the northernmost part of the Pacific Ocean. The Bering Straits connects it to the Arctic Ocean.

The Bering Sea is rich in fish and shellfish and is known for its fierce storms. The volcanic Aleutians mark the border of the Sea

**Coral Sea:** Area is, 1.8 million sq. miles (4.66 million sq km) Its maximum depth is 30,070 feet (9,165 m). It is located southeast of Papua, New Guinea, east of Australia and west of Vanuatu (The New Hebrides). There are deep trenches known as the Vanuatu trenches.

A major feature is the Great Barrier Reef, the largest coral reef in the world. It is also known for the most crucial sea battle of World War II.

**East China Sea:** Area, 290,000 sq. miles (751,000 sq km) Its maximum depth is 8,910 feet (2,715 m). It is located between the coasts of China and the Ryukyu Islands. The East China Sea is a shallow sea with an average depth of 1,145 feet (350 m). It is separated by an imaginary line. It runs to the mouth of the Yangtze River where it connects to the South China Sea.

**Gulf of Alaska:** Area, 592,000 sq. miles (1,533,000 sq km). Its maximum depth is 16,500 feet (5,030 m). It is located to the south of Alaska between Kodiak Island and Cape Spencer. The points of the roughly triangular gulf are Valdez, Kodiak Island, and Cape Spencer.

**Gulf of California: (Sea of Cortez)** Area, 62,000 sq. miles (162,000 sq km). Its maximum depth is 10,000 feet (26,000 sq km). It is located between the west coast of mainland Mexico and the east coast of Baja California.

The northern gulf is shallow and overlaid with silt from the Colorado River. The southern part is deep and with many hydrothermal vents.

**Sea of Japan:** Area, 377,600 sq. miles (978,000 sq km) Maximum depth is 12,220 feet (3,737 m) Its location is to the northwest of Japan and to the east of the Korean Peninsula. It is almost completely enclosed by the Asia mainland and the islands of Japan. The warm Tsushima ocean current flows in from the East China Sea.

**Sea of Okhotsk:** area, 611,000 sq. miles (1,582,000 sq km) Its maximum depth is 11,0060 feet (3,364 sq km). It is located between the far eastern coast of Russia to the Kamohatka Peninsula. In the west is the island of Sakhalin & in the south are the Kurile Islands. It freezes over in winter. In some areas, tides have reached 43 feet.

Fish is an important resource. Gas and oil have been located on the continental shelf.

South China Sea: Area, 1.4 million sq. miles (3.6 million sq km),

Its greatest depth is 16,467 feet (5,019 m), Its location is east of the Philippine Islands, west of Indonesia and southeast of China.. It bounds over 1,700 miles (2,760 km) of southeast Asia.

It is the largest of the seas along the western Pacific Ocean. It supplies half the fish consumed by the people of southeast Asia.

Sulu Sea: Area is 100,000 sq miles (259,000 sq km).

Its greatest depth, 18,400 feet (5,608 m). It is located between Borneo and the central Philippines. It is fringed by over 1,000 small coral islands.

Tasman Sea: Area is 900,000 sq. miles (2,6110,000 sq km);

Its greatest depth is 19,500 feet 5,944 m). It is the sea between New Zealand and Australia. It has dominant warm currents in the summer. During the winter, cold water flows from the south.

It is in the belt of westerly winds known as the Roaring Forties.

Yellow Sea: Area, 205,000 sq. miles(531,000 sq km),

Its greatest depth is 358 feet (109 m). Its location is to the south of the Korean Peninsula and extending to the southeast coast of China. The sea is shallow with a flat bottom. The main part is to the southwest of the Korean Peninsula.

The name is derived from the yellow color of water from the Yellow River. There are many shoals off the coast of China and small islands lie off the shore of Korea.

## SOUTHERN OCEAN

*General:* Prior to 2,000 A.D., the area was included as part of the great Oceans that extend to the Antarctic continent. The area given for the Southern Sea is included in the expanse of the 3 great oceans.

*Size* 7.8 million sq. miles (20.2 million sq km): Over most of its area, it has a depth of about 13,000-16,000 feet (4,000-4,900 m).

*Climates:* The climate over the ocean is very cold. Westerly winds blow more violently than any other ocean, sufficiently enough to affect the surface ocean current. A warmer climate cycle of the earth is affecting the process of ice build up. This, in turn, reduces the ice shelf, which is affecting the growth of *krill* the basic animal food of the pyramid of sea life in the Antarctic. Krill breeds and grows on the under side of the ice shelves.

*Geography* Its floor has a series of basins, separated by ridges. The Antarctic shelf is unusually deep. The whole Antarctic tectonic plate is depressed by the weight of the ice cap.

*Ocean Currents:* The dominant current flows around the continent in a clockwise direction. Very cold water freezes underneath the ice shelf; then, as the water becomes saltier, it sinks and flows north.

*Ocean Life:* Krill is the basic foodstuff of many fish and certain mammals. The cold water is nutrition-rich

### *Coastal Areas, Gulfs and Seas*

Ross Sea: Area is 370,000 sq. miles (959,000 sq km)

The greatest depth is 8,300 feet (2,530 m). It is located on the east of Victoria Land and to the west of Marie Byrd land. It is an indentation into the land of Antarctica. Its southern tip is by the Ross Ice Shelf. The sea floor is mostly a shallow extension of the continental shelf, plunging into the deep ocean at its northern extremity with the Pacific Basin.

The Ross Sea is relatively free of floating ice in the summer.

Scotia Sea: The Area covers 350,000 sq. miles (907,000 sq km)

The maximum depth is 15,000 feet (4,572 m). It is southwest of the Antarctic Peninsula and southwest of Terra del Fuego, Argentina. It is an elongated stretch of water extending west from the 600 mile (960 km) wide channel, Drake's Passage, from the tip of South America to Antarctica.

The Scotia Sea occupies its own tectonic plate, squeezed between the Antarctic Plate and the South American Plate.

Wedell Sea: The area covers 1,11 million sq. miles(2,849,000 sq km)  
The maximum depth is 10,000 feet (3,050 m). It is east of the Antarctic Peninsula and west of Coats Land. It is a large bay south of the Atlantic. Ice and water move around the ocean in a clockwise fashion.  
Much of the sea is covered with an ice shelf. Much of the rest is Permanently covered with an ice pack.

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(a) *Earth, 2003*; Smithsonian, Editor-in-chief, James Luher, pp 396-425.

## RIVERS (a)

AMAZON	3960 mi.(6,348 km)	Brazil, Peru
AMUR-ARGON	2744 MI.(4,400 km)	Siberia.
BRAHAMPPURA	1800 mi. (2,865 km)	Tibet, India, Bangladesh
COLORADO	1450 mi. (2,224 km)	U.S.A.
COLUMBIA	1243 mi. (1,993 km)	Canada, U.S.A.
CONGO	2300 mi. (3,690 km)	Zaire
DANUBE	1777 mi. (2,849 km)	Germany thru 6 countries to Black Sea
EUPHRATES	1700 mi. (2,725 km)	from Turkey, through Syria to Iraq
GANGES	1500 mi. (2,405 km)	India, Bangladesh
INDUS	1880 mi. (3,014 km)	Pakistan, from Himalayas to Arabian Sea
LENA	1661 mi. (2,264 km)	Russia
MISSISSIPPI	3860 mi. (6,168 km)	U.S.A.
NIGER	2690 mi. (4,312 km)	Guinea to Mali to Niger to Nigeria.
NILE	4113 mi. (6,593 km)	Ethiopia, Sudan, Egypt..
OB	3461 mi. (5,548 km)	Russian Siberia
ORINOCO	1800 mi. 2,890 km)	Venezuela
PARANA	2450 mi. (3,927 km)	Paraguay, Brazil
RHINE	820 mi.(1,315 km)	Switzerland to Germany to Netherlands
RIO GRANDE	1996 mi. (3,200p km)	Mexico, U.S.A.
ST. LAWRENCE	1890 mi. (3,030 km)	Canada, U.S.A.
YANGTZE	3460 mi. (5,546 km)	China, Tibet
YELLOW (Huang Ho)	2960 mi. (4,745 km)	China
YENSEY	2560 mi. (4,100 km)	Russia

AMAZON: length,3,960 miles (6,375 km.). (Peru, Brazil)

It is the largest river in the world and the second longest. The river basin covers about 2.7 million square miles (7.0 million sq km) in Bolivia, Brazil, Colombia, Ecuador, and Venezuela. About 2.3 of its rainforest is in Brazil and ranges from 46 to 120 inches (117-305 cm) of rainfall per year. It is about 90 miles (145 km) wide at the mouth; however the Para river is one of the outlets and is 40 miles (64 km) wide. The width from bank to bank, including the Para and the ocean frontage of the island of Marajo (an island the size of Denmark) the distance is 207 miles (332 km.). . A tidal bore is common and may be as high as 15 feet ((4.6 m) during extra high tides and travels at a rate of 10 to 15 miles (16-24 km) an hour. Tides make it impossible for the Amazon to develop a delta. Fresh water is noted far out at sea. The Amazon averages 40 feet (12 m) deep and 1¼ to 6 miles (2-10 km) wide It is navigable for ocean going vessels for over 2,300 miles (3,690 km) to Iquitos, Peru, at an elevation of about 800 feet (245 m). River flow is about 11/2 miles (2.4 m)an hour during the dry season and up to 3 miles (5 km) an hour when the river is swollen. Its source is in the Andes Mountains. About 200 smaller rivers enter the Amazon. b)

(Amazon - Wikipedia)



AMUR: length, 2,744 miles (4,445 km.). Eastern Siberia partly along the Chinese border. The river basin is about 712 thousand sq. miles (1,844 sq km). It is a large river formed by Agun and Shiik Rivers. Large boats operate for most of its length. It flows along the Chinese border, turning north and emptying into the Tara Sea and into the North Pacific Ocean. The river is navigable over most of its length during the summer months.©

BRAHMAPURA 1,800 miles (2,920 km.)

It rises on the northern slope of the Himalayas in Tibet, flowing through Assam, eastern India and Bangladesh to the sea where it shares the delta with the Ganges R.

Boats use the river for 80 miles (130 km).(d)

COLORADO: length, 1,450 miles (2,450 km.).

It drains an area of about 200 thousand sq. miles (51,000 sq km).

It rises in central Colorado, west of the Great Divide, through Utah & Arizona into the Gulf of Mexico in northwest Mexico. Tributaries are the Green, the San Juan, and the Little Colorado rivers. The river is known for the grandeur of its canyons. It was also famous for rapids, floods, and its silt filled water. Two Great dams now restrict the flow, the Glen Canyon Dam and the Hoover Dam now regulate the river flow.

GLEN CANYON DAM forms Lake Powell

HOOVER DAM forms Lake Mead

The water of the Colorado River is fully utilized with water to several cities and for irrigation in the Imperial Valley. The river is virtually dry at the delta in NW Mexico. A seven-state water rights pact was signed about eighty years ago. Overuse of water by some states will require negotiations and adjustments in water use and water rights. Other dams on the lower Colorado are the Davis, Parker, Imperial, Navajo, and Flaming Gorge Dams.(e)

COLUMBIA: 1,243 miles (2,014 km.). (Canada &U.S.A.)

It drains an area of about 250 000 sq. miles (65,000 sq km). The Columbia, once one of the richest salmon rivers in the world, has virtually no salmon because of the many dams (14) interrupting its flow. Including the 14 dams on the Columbia, there are a total of 34 dams on the Columbia and its tributaries. Hydropower is vital to the Northwest.

Attempts to ferry the mature salmon upstream and the fingerlings downstream have been relatively unsuccessful. The river begins in Columbia Lake in S.E. British Columbia.

1/3 of all hydroelectric power in the U.S. comes from the Columbia. It is also important for irrigation.(f)

BONNEVILLE DAM

GRAND COULEE DAM

CONGO: length, 2,300 miles (3,730 km.). (Zaire)

It is the second largest river in the world, and drains an area of about 1.400,000 sq miles (3,630,000 sq km) in Central Africa. A series of rapids and waterfalls, where the river descends 800 feet (245 m), separate the upper and lower Congo. The Congo has no delta as the water drops into a deep ocean trench in the Atlantic Ocean. The upper Congo

& its many tributaries are important for transportation. Ocean-going ships navigate the Congo as far as Matadi. The upper Congo is important as the only major transportation artery in the Congo.(g)

DANUBE: length, 1,777 miles 2,879 km.).

(Germany, Austria, Hungary, Bulgaria, Romania)

It is the largest river in Europe. It passes through southern Germany and Austria and is part of the border between Hungary and Slovakia. It touches Croatia and flows along the borders of Bulgaria and Romania and finally into the Black Sea. It is extremely important as a waterway and is connected to the Rhine by canals. There are a number of dams on the Danube, the largest of which is called the Iron Gate.

The Danube is highly polluted. The Iron Gate Dam produces enough electric power for Romania and the former Yugoslavia.(h)

EUPHRATES: length, 1,760 miles, (2,851 km.) (Turkey, Syria, Iraq)

The river originates in mountains of eastern Turkey. The river flows SW until it reaches the lowlands of Syria; then it turns to the E and flows through Iraq until it joins the Tigris near the Persian Gulf. The river has been important currently and historically for its water for cities and irrigation. Several dams have been proposed for the upper river. Plans by Turkey to further utilize its water would be a disaster for Iraq and Syria.(i)

GANGES: length, 1,500 miles (2,430 km.). (India, Bangladesh)

Its source is in the Indian Himalayas. Its course is through eastern India and Bangladesh. In the Hindu faith, it is the Holy River. The Ganges is a large river and important for transportation. Its valley is fertile and heavily populated.(j)

HUDSON RIVER: length 315 miles (507 km.).

Its source is Lake Tear of the Clouds, a postglacial lake in the Adirondack Mountains. The lower 150 miles from Troy, New York to the lower New York Bay, is actually a tidal inlet, and tides affect the water level all the way to the Federal Dam at Troy. During high tides, seawater may mingle with the fresh water as far as Poughkeepsie, 75 miles (120 km) upriver. The Federal Dam is used as lock 1 of the New York State Canal Systems canal that runs north to the St Lawrence River

*Hudson River – Wikipedia*)

INDUS: length, 1,880 miles (3,045 km.). (Pakistan, Tibet).

It drains an area of 375,000 sq. miles (970,000 sq km).

The river's source is N of the Himalayas in Tibet, and flows south to the Arabian Sea. The Indus valley was a major location of early civilizations prior to a change in the path of the monsoons. One of the largest dams in the world is on the Indus and several of the world's largest irrigation projects. So much water is used for irrigation that the river is suitable for small craft only.(k)

LENA: length, 1,661 miles (2,690 km.) (Russia).

It drains an area of 1,000,000 sq. miles ((2,590,000 sq. km.).

Its source is in the Baikal Mountains and flows to the Arctic Ocean. It is especially important for transportation. Ships can sail up the Lena for about 2,000 miles (3,200 km). Its estuary is about 50 miles (80 km) wide. It empties into the Arctic about 1,6500 miles (2,645km) East of the Bering Sea.(l)

LOIRE: length, 654 miles (1,052 km.),

The basin, 45,000 sq. miles(117,000 sq km).

It rises in the Massif Central about 100 miles (160 km) from the Mediterranean, meanders in a high-walled valley and turns west to the Bay of Biscay. The flow is irregular, depending on the season. (*Loire River – Wikipedia*)

MACKENZIE: length, 2,635 miles (4,242 km.) (Northwest Territory, Canada).

It drains about 658,000 sq miles (1,698,000 sq. km.). It is the second largest river in N. America.

It flows from the Great Slave Lake to the Beaufort Sea. Barge traffic extends through much of the river system in summer. The valley is rich in minerals and the southern (Peace River area) is rich farmland.(m)

MADEIRA: length, 2,060 miles (3,317 km.). Brazil

It is an important branch of the Amazon River and an important waterway.

MISSISSIPPI MISSOURI: length, 3,860 miles (6,214 km.).(United States)

It drains an area of 1,247,300 sq. miles (3,218,000 sq. km.). Its source is L. Itasca in northern Minnesota. The Missouri's source is southwestern Montana.

Its major tributaries are the Yellowstone, Missouri, Ohio, Cumberland, Tennessee, & Red Rivers. The Mississippi is navigable from Minneapolis-St. Paul to New Orleans. The river contains a contradiction in names. The Yellowstone River is larger than the Missouri at their confluence. The Missouri is larger than the Mississippi at their confluence. The Ohio River is twice the size of the Mississippi at their confluence. The lower Mississippi has been shackled by the levees since the 1800's when the Government decided to support river traffic and has the river under strict control. The problem is that the riverbed is continually building up as silt is deposited. The Corps of Engineers has built up the levees to compensate. In some places the riverbed is higher than the flood plain. A major flood such as the one in 1997 when the Missouri River overran its banks and much of the Missouri and Illinois floodplains were inundated when the levees failed. It is inevitable that the Mississippi will breach the levees again. The Mississippi above New Orleans may well change its course and bypass New Orleans and enter the Gulf to the West. The delta of the Mississippi is sinking as oil and chemicals are pumped from the seabed. Much of the farmland is disappearing and the swampland that protects New Orleans is eroding.(n)

MISSOURI RIVER: length, 2540 miles 4,090 km..

It drains an area of 535,000 sq. miles (1,385,000 sq km). It is a major tributary of the Mississippi. It officially begins at the confluence of 3 small rivers in SW Montana. It flows through Northern Montana, then turns SE, flowing through N. & S. Dakota, Ne-

braska, Kansas, and Missouri. It was an important transportation artery before the advent of the railroads. In 1937, the Fort Peck earthen dam was built to provide power and flood control. Since then, five additional dams have been built on the Missouri. It marks the southern limit of the great ice sheets. At one time, it flowed to the Hudson Bay. There are still signs of the old riverbed that followed the Canadian border in Western North Dakota.(p)

MURRAY-DARLING: length, 2,310 miles (3,719 km.). (Australia)

It drains an area larger than France and Spain combined. It rises in the Australian Alps and flows South and Southeast. It enters Encounter Bay South of Adelaide. Sixteen large hydroelectric dams have been built and there is enough water to irrigate 1,000 sq. miles (2,600 sq. km.) (o)

NIGER: length, 2,669 miles (4,297 km.). (Somali, Mali, Guinea, Niger, & Nigeria)

Its drainage basin covers 580,000 sq miles (1,502,000 sq km) and handles more water than any African river except the Congo. In Nigeria, it is joined by its main tributary, the Benue River and empties through a large delta area into the Gulf of Guinea, an arm of the Atlantic Ocean. Boats can navigate about 1,000 miles (1,600 km) of the river in Mali and 400 miles in Nigeria.. Transportation and fishing are important.(q)

NILE: length, 4,113 miles (6,622 km.). The source of the Blue Nile is Ethiopia.

The source of the White Nile is Lake Victoria. The Blue Nile is the source of the soil that once built up the Nile delta and fertilized the Nile valley. The White Nile flows through many low areas after it enters the Sudan. The Blue Nile carries more water (70%) annually than the White Nile. Their confluence is at Khartoum in the Sudan. In 1968 the Aswan High Dam began operating. The Dam's electric output is the source of Egypt's electric power. Water is metered out on an annual basis for irrigation. The downside is that the delta is no longer receiving the flood waters and silt and is becoming highly polluted and, without the silt renewal, is gradually sinking below sea level. A new delta is forming in the reservoir above the Dam. Silt is reducing the capacity of the reservoir.®

OB: length, 3,461 miles (5,572 km.). (Siberia).

It drains almost 1,100,000 sq. miles. It rises in the Altai Mountains and flows Northward to the Gulf of Ob in the Arctic Ocean. It lies West of the Lena River. There are about 19,000 miles (30,000 km) of navigable waters on the Ob and its tributaries. It is especially important for shipping grain and other Agricultural products, both to the railways and to the Arctic Ocean for transshipment.(s)

ORANGE RIVER: Length, 1,356 miles (2,200 km.). Africa, Lesotho & South Africa. .

It rises in the Drakensberg Mountains and flows into the Atlantic ocean. It forms part of the border between South Africa and Namibia. *Orange River – Wikipedia)*

ORINOCO: length, 1,800 miles (2,860 km.). (Venezuela)

It has 2 known sources, both in the Parina Highlands near the border of Brazil. It flows northward and forms part of the border between Colombia and Venezuela. Then it swings eastward through Venezuela. It divides into many channels at its estuary on the Caribbean Sea. Many ocean-going ships can sail about 200 miles (360 km) up the Orinoco. The Orinoco and its tributaries have a navigable length of about 4,300 miles (6,900 km) (t)

*Angel Falls* 3,215 feet (980 m) high (from a high plateau on the Charon River, which joins the Orinoco.

PARAGUAY: length, 1,584 miles (2,550 km.) (Brazil, Paraguay)

It rises in South Central Brazil and flows South, bisecting Paraguay to its confluence with the Parana at the Argentina border. It is navigable all the way to Asuncion, the Capital city of Paraguay.(v)

The Paraguay drains the largest wetlands in the world. Commercial navigation handles traffic only less than the Amazon. Its confluence with the Parana about 510 miles (815 km) before the confluence with the Uruguay River to form the Rio de la Plata.

A controversial plan to dredge the Paraguay and build a series of hydroelectric dams has been tentatively agreed upon by the several nations served by the river. (*Paraguay River – Wikipedia*)

PARANA: length, 2,450 miles (3,940 km.). 7<sup>th</sup> largest river in the world.

It rises in Southern Brazil where the Rio Grande and Paraiba Rivers meet. It flows South through Brazil and forms part of the border between Brazil and Paraguay. It turns and makes part of the border between Paraguay and Argentina. It crosses part of Argentina and empties into the estuary called the Plata River (Rio de la Plata). Ocean-going vessels can travel about 400 miles (640 km) from the Atlantic. The Paraguay is the main tributary of the Parana.(u)

The river is dammed by the *Itaipu* dam (with the largest hydroelectric power station in the world) and the Yacyreta hydroelectric dam. (see dams) (*Parana River - Wikipedia*)

PLATTE RIVER length with North Platte 900 miles ((1,448 km).

It drains 90,000 sq. mi. (233,000 sq. km.) of Nebraska and the eastern slope of the Rocky Mountains. It is said of the Platte that it is a mile wide and an inch deep. Someone else said that, when you cross Nebraska, you knew you had reached the Platte by the dust cloud. The Platte has a heavy flow after storms and in the early spring. It was important in the 1800's during the migration west. (*Platte River – Wikipedia*)

PURUS: length, 1,900 miles. (3,0060 km.)

Its drainage basin 24,000 sq miles (63,160: km sq.) Its head waters are in Peru and it flows in a general northeasterly direction through the Brazilian rain forest to the Amazon. Its mean flow is 2.2 million gal. Per second (8,400 cu m. per second). It enters the Amazon west of the Madeira R. It is one of the most winding rivers in the world. For 1,000 miles (1,6900 km.), its width is very uniform and its depth is never less than 45 feet (15 m.). It is navigable by steamer for 1,648 miles (2,650 km.) (*Purus River – Wikipedia*)

**RHINE:** length, 820 miles (1,220 km.). (Switzerland, Germany, Netherlands)

It drains about 88,700 sq. miles (230,000 sq km). It forms part of the border of Switzerland, Liechtenstein, Austria, France and Germany. It flows through Germany and the Netherlands into the North Sea. It flows eastward in Switzerland from two glaciers near the Italian border to the border with Austria and Liechtenstein, turning west through Lake Constance (1,306 feet, 396 m, above sea level) along the German border, to Basel, landlocked Switzerland's port to the sea. It then turns North along the French-German border and on through Germany and the Netherlands. Major tributaries are the Neckar, Main, Lahn, Ruhr, Lippe, Nahe, and Moselle. Canal systems connect the Rhine to French rivers and to the Danube in the East. The Rhine is a major waterway of Europe. It is also a part of the history and mythology of Germany.(w)

**RHONE:** length, 500 miles (800 km.), basin, 37,000 sq. miles.. (Switzerland, France)

It rises in the Rhone Glacier in Switzerland, flows through Lake Geneva and west into France. At Lyons, it turns south into the Mediterranean through a large delta. It is navigable for 300 miles and is connected by canal to Marseille and to other major European rivers. It is known for its great beauty.(x)

Its main tributary the Saone , joins it near Lyons.

**RIO GRANDE:** length, 1,920 miles (3,090 km.). (Mexico, U.S.)

It rises at the Continental Divide of the Rocky Mountains of SW Colorado. It flows East and then South through New Mexico. It enters Texas at El Paso and marks the border between Texas and Mexico. There are a number of dams on the upper Rio Grande as well as reclamation projects and a number of parks including Big Bend National Park. Most of the water is utilized by cities and irrigation projects. The river is not important for transportation.(y)

**ST. LAWRENCE:** length, 1,890 miles (3,040 km.) The river flows about 800 miles (1,280 km) from lake Ontario to the Gulf of St. Lawrence. It drains an area of about 496,500 sq. miles (1,285,000 sq km). The source of the St. Lawrence system is the St. Louis River, which enters Lake Superior at Duluth, Minnesota. St. Lawrence is only 20 feet (6 m) above sea level at Montreal. The St. Lawrence has become an international waterway since the completion of the St. Lawrence Seaway, which makes it possible for large freighters to pas from the Gulf of St. Lawrence into the Great Lakes.(aa)

It is only 7,000 years old. Tides affect the river as far up-river as Quebec City.

**SALWEEN:** length, 1,780 miles (2,870 km.)

It rises in Tibet, flows through South China and through Myanmar to the Andaman Sea. The river flows through deep canyons until it reaches Myanmar. It is navigable for about 50 miles (80 km.) and then only in the rainy season. The river valley is one of the most prolific for flora and has many rare and endangered species of animals. The river is the longest river without dams in southeast Asia. The Chinese halted construction of 13 dams in 2004. "*River, Salween*"; *Wikipedia*

**SAO FRANCISCO:** length, 1,800 miles (2,900 km.). (SE Brazil)

It originates in the Brazilian highlands, flowing Northeast over rapids and waterfalls. It then turns Southeast into the Atlantic Ocean. Two hundred miles (320 km) from the Atlantic it goes over the Paulo Alfonso Falls. It is a broad, navigable stream for 900 miles (1,440 km). It is important for irrigation, transportation, and hydroelectric power.(z)

SENEGAL RIVER: The length is 1,100-mile (1,700 km.).

The river is in West Africa, on the border between Mauritania and Senegal with its source in Guinea. It flows west and south just back of the beach of the Atlantic. The river has two major dams, the Manantali Dam in Mali and the Maka-Diana Dam on the border between Somalia and Mauritania. Its drainage basin is 186,000 sq. miles. (481,000 sq km.). (*Senegal River - Wikipedia*).

SYR DARYA: Length is 1,380 miles (2,221 km.) and drains an area of over 300,000 sq miles, (800,000 sq km.) in Kazakhstan, Tajikistan and Uzbekistan in Central Asia. It flows into the Aral Sea. The waters are used for irrigation and the river no longer flows into the Aral. The river rises in the Tien Shan Mountain Range. The river is relatively modest and the water is used in Turkestan as well as the cotton-growing area of Uzbekistan. Poor irrigation practices have materially reduced productivity of the soil. (*Syr Darya – Wikipedia*)

TAGUS: length is 626 miles (1,007 km.). (Spain, Portugal)

The basin is 33,500 sq. miles (87,500 sq km). It rises in the Sierra de Albarralra and flows past Toledo, Spain. Its estuary is at Lisbon, Portugal and forms one of the finest harbors in the world. It is used by both Spain and Portugal for power and irrigation. (*Tagus River – Wikipedia*)

THAMES: length, 210 miles (340 km.). southeast England.

The lower 90 miles (144km) are tidal. The source is in the Cotswold's. It is especially important for commerce at London and other ports in its estuary. The Thames has been a major player in the history of England. During the little Ice age the river was completely frozen over 12 times between 1149 A.D. and 1517 A.D. High tides have made it necessary to build river gates to control the river level.

(*“River Thames, www.Wikipedia*)

YALU: Length, 491 miles (700 km.)

Northeastern China and flowing to the Pacific on the border between North Korea and China. Although the river widens to 3 miles (5 km.) it is no deeper than about 10 feet (3 km.) and is not generally navigable. It flows southerly from the Baekdu Mountains and then easterly. (*Yalu River- Wikipedia*)

YANGTZE: length, 3,460 miles (5,485 km) (China, Tibet)

It drains about 700,000 sq. miles (1,690,000 sq. km.).

The Yangtze rises in the Tangula Mountains of Qinghai Province and follows an irregular course to the East China Sea near Shanghai.. About half of China's ocean trade is along the Yangtze and its tributaries. Ocean-going vessels travel as far as Wuhan, 686 miles (1,098 km) inland from the Sea. In 1994 the Chinese Government began the construction of the Three Gorges Dam, which will be the largest dam in the world, with a maximum length of over 2 miles (300 m) and a maximum reservoir depth of over 600 feet or 185 meters. The reservoir, when filled, will be one of the largest in the world and make it possible for ocean-going vessels to pass through the 3 gorges to China's major industrial area of Chongqing (Chungking), a major river port 1,600 miles (1,600 km) upriver) and Chengdu. (ab) (*Yangtze River – Wikipedia*)

**YELLOW: (HUANG HO)** length, 2,960 miles (4,670 km.). (China)

It drains an area of about 400,000 sq. miles (1,004,000 sq km.). It flows East from Qinghai Province to the Yellow Sea. It is shallow and wide and is subject to frequent floods. Dikes have been ineffectual because the river frequently changes its course. The river is not generally navigable. The flow of the river is seasonal and there is very little water during the dry season. The government plans to direct a flow from the Yangtze after the completion of the Three Gorges Dam.(ac).

Floods of the yellow River have claimed a million or more lives over the centuries. (*Yellow River – Wikipedia*)

**YELLOWSTONE:** length, 671 miles 1,080 km.). (Wyoming, Montana, U.S.)

It rises along the Continental Divide, and flows through Yellowstone lake (137 sq. miles(397 sq km). It then flows North, East and finally North to join the Missouri at the North Dakota border. It is the largest free-flowing river in the U.S. (ad)

(*Yellow River – Wikipedia*)

**YENISEI:** length 3,443 miles (5,439 km.) Russia, Siberia,

It is the greatest river system in Russia and the fifth longest river in the world. It has 1.5 times the flow of the Mississippi. Rising in Mongolia, it follows a northern course to the Kara Sea (Arctic Ocean). The system is the Yensei—Angra-Selenga-Ider. Lake Baikal drains through the Angara River, a tributary of the Yensei. There are many hydroelectric dams on the tributaries of the Yenisei. (*Yenisei River – Wikipedia*)

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(a) "Great World Atlas", 1966, Readers Digest, Pleasantville, N. Y. p. 152.

(b) "World Book), 1987, Volume 1, pp 401 ff.

(c) Ibid. p 446.

(d) Ibid, Volume 2, p 548.

(e) Ibid. Volume 4, pp 840-1.

(f) Ibid, Volume 4, pp 852-3

(g) Ibid, Volume 4, p 940

(h) Volume 5, p 35

(i) Ibid, Volume 6, pp 378-9.



- (j) Ibid, Volume 8, p 26.
- (k) Ibid, Volume 10, pp 240-41
- (l) Ibid, Volume 12, p 190.
- (m) Ibid, Volume 13, p 23.
- (n) Ibid, Volume 13, pp 737 ff.
- (o) Ibid, Volume 13, p 932
- (p) Ibid. Volume 13, pp 674 ff.
- (q) Ibid, Volume 14, p 409.
- (r) Ibid, Volume 14, pp 422,3
- (s) Ibid. Volume 14, p 642.
- (t) Ibid, Volume 14, p 856.
- (u) Ibid, Volume 15, p 153.
- (v) Ibid, Volume 15, p 150.
- (w) Ibid, Volume 16, pp 292.
- (x) Ibid, Volume 16, p 319.
- (y) Ibid, Volume 17, p 117.
- (z) Ibid, Volume 17, pp 41-45.
- (aa) Ibid, Volume 21, pp 521-2.
- (bb) Ibid, Volume 9, p 403.
- (cc) Volume 21, pp 560.
- (dd) Volume 21, p 564.

## DAMS

All dams are proposed on the basis of certain advantages. Proponents emphasize these quite strongly.

- (1) Hydroelectric power.
- (2) Flood control
- (3) Irrigation
- (4) Recreation
- (5) Drought storage

The downside;

- (1) Loss of farmland
- (2) Loss of migratory fish stocks
- (3) Silting (see comments below)
- (4) Displacement of people
- (5) Loss of historical sites.
- (6) Degrading of Deltas
- (7) Engineering Design Flaws
- (8) The effect or danger in areas of tectonic faults
- (9) Loss of water through evaporation in dry climates

Silting is a problem to be considered in all dam construction. It might be termed the obsolescence factor. Rivers that run through desert areas or from high mountains present a greater problem. If there are ephemeral rivers in desert areas the ability of the water to carry silt maybe as much as 400 times that of most rivers. Alluvial plains erode easily and rains falling in these areas will carry a great deal of silt.

*(New Science Website, 18 December, 1993. "Desert Rivers put dam Schemes in Doubt*

## FAMILY OF DAMS

In the case of the Missouri River system, a series of dams were planned and built the control flooding and, in the case of power usage, the upper dams would store water for the use of power in the lower dams. From the upper to the lower in order they were the Fort Peck Dam, the Garrison Dam, Oahe Dam, Big Bend Dam, Randall Dam and Gavins Point Dam, and Five are earth fill dams and Fort Peck us of a hydraulic fill from the bottom of the river. The system was authorized by the "Flood Control Act of 1944. Although some believe that hydraulic fill is a system that would ultimately fail because of liquefaction, the Cors of Engineers assure us there is no danger. Failure of the dam when the reservoir is nearly full would destroy all six dams. The six reservoirs have enough capacity to 3 years of normal Missouri River flow.

**Hydraulic fill:** is prone to liquefaction under stress or earthquake, causing total failure of such a dam.

The spring of 2011 saw a snowmelt of 212% of average, and record rainfall in Montana in May. The result was the filling of all six reservoirs and a flow of 1550,000 cu feet per second, by far the largest on record.

DAM\	FILL, YD.	HEIGHT	LENGTH	ACRE FEET
Fort Peck	125 Mil.	250 feet	21,026 ft.	18.7 Million
Garrison	66. Mil	210 feet	11,300 ft.	24.0 Million
Oahe	99 Mil.	245 feet	9,300 fft.	23.5 Million
Big Bend		95 feet	10,270 ft	2.5 million (est)
Ft. Randall		165 feet	10,700 ft.	5.7 million
Gavins Point	7 mil.	74 feet	8,700 ft	0.5 million

## MAJOR DAMS

**ASWAN HIGH DAM:** Egypt on the Nile just north of the border with the Sudan.

The length is 11,300 feet (3,960 m). It is 131 feet wide (40 m.) at the crown; 3,530 feet wide (980m.) at the base, and 328 feet (111 m.) in height. The dam contains 56,500,000 cu. yards (43,000,000 cu m.) of material. The reservoir (Lake Nasser) is 327 miles (550 km. Long, 22 miles (35 km.) wide at its widest, and covers 2,010 sq miles (5,250 sq. km.

About 72 billion cu yards (55 billion cu m.) is released each year. This is about 43,000,000 acre-feet of water. About 73% is used for irrigation. Nearly every crop except sugar cane produces 2 crops a year. Prior to the Aswan Dam, large floods could destroy the crops and in years of low flood, crop failure would occur. (*Aswan Dam – Wikipedia*)

Much of the reservoir area was farmland. A new delta of the Nile is forming above and in Lake Nasser. The loss of capacity is not given but it is significant. (*Lake Nasser – Wikipedia*)

**BANQUAIO SHUIKU DAM:** China, East central. It was built on the Ru River

It was a 431-foot (131 m.) high concrete dam. Final designs allowed for a crest of 380 feet (116 m.). The structure had been reinforced when cracks appeared on the face of the dam. The dam was designed for flood control and hydro power.

A series of three typhoons hit the area on August 5-7 of 1975 for a total of over 1 meter (40 inches) of rain. Sedimentation and inadequate capacity of sluice gates caused failure of the dam. A total of 62 dams failed during this three-day storm. (See Floods) *Banqiao Dam – Wikipedia*)

**BONNEVILLE Dam** Columbia River (Washington, U.S.)

Length of dam is 3,463feet (1,027 m.): Reservoir 48 miles (77 km.) long. Generating capacity (10 generators) 520,700 kw. A second powerhouse with 8 generators has the additional capacity of 525,000 kw. (*Bonneville Dam – Wikipedia*)

In spite of fish ladders and other procedures, the salmon run has been reduced to an insignificant population.

**FORT PECK DAM:** Missouri River, (Montana, U.S.),

The dam is 20 miles (32 km) south of Glasgow, Montana..

Construction was begun in 1933 and finished in 1937. Most of the workers lived in shack towns such as New Deal, Square Deal, & Wheeler. The town of Fort Peck is a permanent settlement.

Hydropower from 5 generating units is 185,200 kilowatts.

It is an earth fill dam with a steel core. It is one of the largest hydraulic filled dams in the world. The earth was pumped as slurry by 2,500 hp electric motors and long pipes. The main structure is 2 miles (3.2 km) long with a base ½ mile (790 m) thick and the crown is about 300 feet (90 m) across. The total dam length is 21,026 feet (6,409 m), and the height is 250.5 feet (76.35 m).. The dam has 4 tunnels with towers, each tunnel about 20 feet (6 m) in diameter. The lake is about 134 miles (216 km) long, the fifth largest in the United States. Twice, since 1943, the spillway has run nearly full because of unusually large runoffs. In 2007, the lake is down 40 feet because of drought or low snow pack.

*(Fort Peck Dam – Wikipedia)*

**GLEN CANYON DAM:** Colorado River (U.S.) near Page, Arizona.

Construction began October 15, 1956 and completed in 1964 The dam is 710 feet (2165 m.) high and 1,560 feet (475 m.) wide at the crest. In bulk, it is one of the largest dams in the world.. Its reservoir “Lake Powell” is 585 feet (178 m.) deep.

The power plant has 8 generators with a capacity of 1.356 million kilowatts. The maximum discharge from the generators is 33,200 cfs (cubic feet per second); the river outlet is 15,000 cfs and the spillway can release up to 208,000 cfs.

Lake Powell is basically for water storage and power generation. Most of the people in favor of the project have had second thoughts. In 2007, Lake Powell was down about 100 feet, reducing its volume to about half of capacity. Much of the beauty of Glen Canyon and branches, normally under water, are now revealed. *(Glen Canyon Dam – Wikipedia)*

**GRAND COULEE DAM:** Columbia River, (Washington, U.S.A.)

The dam is 90 miles N.W of Spokane, Washington.

It is the largest single source of water power in the U.S. with four powerhouses, adding 24 generator to the original 9. Grand Coulee played a major role in World War II, powering the Hanford Atomic Complex as well as furnishing power to produce aluminum, vital for aircraft. It is the largest concrete structure in the U.S.A. Length is 5,223 feet (1,523 m) and a height of 550 feet (168 m.). The reservoir is 510 feet (155 m) deep.

The Grand Coulee, a dry former riverbed is used as storage for irrigation. It is also used in storage and reuse of water for power.

In the process of building the dam, much rich land owned by local tribes was taken and the tribes and their graveyards were relocated. In addition, their livelihood depended on the salmon runs, which ceased by the time the dam was completed.

*(Grand Coulee – Wikipedia)*

**HOOVER DAM:** Colorado River, (U.S.)

The dam is 45 miles north of Las Vegas on the border between Nevada & Arizona. Construction was begun in 1931 and was finished in 1936. It is a concrete, arch, gravity dam.

The original location was to be Boulder Canyon, later changed to Black Canyon. The length is 1,244 feet (379 m.) and the height is 726 feet (221 m.)

Thirteen deaths were recorded in construction, however, heat in the canyon was often over 110 F. (44 C) and sometimes over 120 F. (50 C.). (Death from sunstroke was not recorded nor were the many casualties from carbon monoxide during tunnel construction.)

The seven turbines generate a total of 2,074 megawatts.

Lake Mead: 110 miles long (177 km.); area, 157,900 acres (639 sq. km.). The volume is 28,537,000 acre feet (639 cu. km.) Surface elevation at full volume is 1,221.4 feet (372.3 m) above sea level. (*Hoover Dam – Wikipedia*)

### **ITAPU DAM:** South America.

It has one of the largest hydroelectric output in the world.

The dam structure is 644 feet (196 m.) high and its length is 4.8 miles (7.76 km.). The reservoir is 1099 miles (176 km.) long. The lake covers 536 sq. miles (1,350 sq. km.)

The power plant has 20 turbines with 18 on line at 725 mw. Each with a total output of 13,000 megawatt, achieved 50% of the time.

The cost was 20 billion dollars (2006 value). About 10,000 families were displaced. The power plant produces as much energy as 434,000 barrels of petroleum per day. (*Itaipu – Wikipedia*)

### **KATSE DAM:** (Lesotho) height: 606 feet (185 m.) Reservoir filled in 1997.

It is part of the Lesotho Highlands water project. A total of 5 high dams are planned.

Lesotho has very little arable land and farmers, displaced by the dam and reservoir, have had difficulty in finding new locations. Water is transferred to a power plant by means of a 28 mile (45 km.) tunnel. Water is used by South Africa and local farmers; are not allowed to take water from the reservoir. In several drought years, Lesotho has required food aid. (*Katse Dam” www.Wikipedia*)

### **MANGH DAM:** (Azad Kashmir, Pakistan) on the Jhelum River.

It is a tributary of the Indus River, and is located about 100 miles (160 km.) southeast of Islamabad. It is the 12<sup>th</sup> largest dam in the world. The length of the dam is 10,300 feet (3,140 m.) and the height is 454 feet (138 m.). The reservoir covers 97.7 sq miles (253 km.). Since its impoundment in 1967, the river had sedimentation, reducing its capacity from 5.88 million acre feet (7.25 cubic km.) to 4.75 million acre feet (5.65 cubic km.).

The building of the dam displaced over 110,000 people, many of whom were given work visas for the United Kingdom.

The dam was constructed under the terms of a treaty with India that allotted the waters of certain rivers to Pakistan and others to India. (*Mangh Dam” www.Wikipedia*)

**OROVILLE DAM:** Oroville Dam is on the Feather River in California, U.S.A.

It is in the Sierra Nevada Range, about 60 miles (96 km) south of Redding, CA.

The dam is an earth fill dam completed in 1961. Maximum thickness is 33,570 feet (1,087 m.), length at crest is 6,920 feet (2,100 m.). Crest width is 80 feet (24 m.).

The purpose is for irrigation, water storage, flood control and hydropower. Hydropower units are capable of producing up to 67,728 megawatts of power. [www. Oroville Dam](http://www. Oroville Dam)

**SAINT MARGUERITE** Quebec Province, Canada

Construction began in 1994. Height of the dam is 472 feet(144 m.).

Most information on the dam and reservoir is classified and difficult to obtain.

*Reservoir Induced Earthquakes at St. Margharete –Internet)*

**SHASTA DAM** California, USA, the Sacramento River. Near Shasta lake City.

The length is 3,460 feet (1,055 m) and height is 602 ft (183 m). Width at base is 543 ft (1655 m). The reservoir has a surface area of 30,315 acres (123 sq km). It is a multipurpose dam for irrigation, flood control, recreation, and hydroelectric. Capacity of 5 generators is 610 megawatt. (*Shasta Dam – Wikipedia\_*

**TARBELLA DAM:** Earth and Rock construction, height, 485 feet (150 m.)

The reservoir, 95 sq miles 246 sq. km.), was completed in 1977 on the Indus River, (Islamabad, Pakistan). It is one of the largest in the world.

It is important both for hydroelectric and irrigation.

The dam was damaged in October, 1992 by an earthquake in northern Pakistan. Loss of capacity because of silt. Gross storage capacity was 11.62 MAF (million acre feet). Operating capacity was 9.7 MAF. Silt deposited in the reservoir is estimated at 0.26 MAF per year.

Hydroelectric power generation capacity is 3.476 megawatt. The question arises as to the effective operating life of the dam, given the estimated rate of silting. .

*(Tarbella Dam – AOL: Tarbella Dam)*

**THREE GORGES:** Yangtze River, (China) The largest dam in the world.

**Statistics:** The height is 607 feet (1865 m.); length, 7,6661 feet (2,335 m.); thickness at base 337 ft. (115 m.) and at the crest 131 ft. (40 m.). It required 30 million cu yd (23 Million cubic m.) of concrete, 434,000 tons of steel and moved about 175 million yard (134,000 cubic meter) of earth. There will be 32 turbines,, each capable of generating 700 megawatt, a total of 22,500 megawatt. The reservoir will be up to 400 miles (644 km) long and 70 miles (112 km.) wide and cover 379 sq. mi. (632 sq. km).

**Benefits:** Navigation: It is expected to be able to handle 50 million ton of freight, up from 10 million ton per year. It takes about 4 hours to navigate the 5 locks into the reservoir. They are 919 x 113 x 164 ft. (280 x 35 x 50 m.) in dimension.

Flood Control and drought: It is forecast that major flooding will be reduced from 1 in 10 years to 1 in 100 years. Plans are to build a canal across southern China to bring water to traditionally drought stricken areas.

Hydroelectric power: Hydro power is estimated to take the place of about 30 million ton of coal per year with an accompanying reduction in air pollution and greenhouse gases.

### **Criticisms.**

- (1) **Pollution:** Major upriver areas, especially Chongqing (Chunqing) metropolitan area which is in early stages of controlling industrial and metropolitan pollution.
- (2) **Loss of habitat:** About 1,200,000 people had to be relocated. It is estimated that about 4,000,000 people will be affected. In many cases recompense is far less than it will cost the peasant farmers to replace their farms..
- (3) **Endangered species:** A number of endangered species will be seriously impacted especially the Shanghai Crane and river dolphin.
- (4) **Cultural Loss:** Thousands of villages had to be abandoned and the residents moved to new locations. These villages had centuries of customs and were relatively self sufficient. Being moved from their homes and friends into high rise buildings is traumatic.
- (5) **Historical Artifacts and locations:** Over a thousand location of historic significance and many artifacts in them have been flooded and lost.
- (6) **Silting:** Up to 500,000,000 ton of silt is brought down t the area of the reservoir each year. This has a number of consequences.
  - (1) Changqin, a major industrial area, is at the head of the reservoir. Silting of its harbor will shortly become a problem. It is estimated that about 100 million ton of silt will have to be dredged annually to keep the harbor open.
  - (2) Silt will eventually clog the intakes to the hydroelectric turbines, With resulting reducing their effectiveness.
  - (3) Lack of silt in the water below the dam will speed the flow of water, thereby increasing the erosion of riverbanks and dikes.
  - (4) Gradual loss of the delta structure and it is no longer being renewed.
  - (5) It is also feared that this may also affect Shanghai, which is built on alluvial soil.

*(Three Gorges Dam – Wikipedia)*

**YACYRETA DAM:** on the Parana River between Argentina and Paraguay.

It is one of the largest dams in the world. The dam is 2,650 feet (808 m.) long and the reservoir covers 620 sq. miles (1,600 sq. km.). The power plant has 20 turbines with a total output of 4,050 megawatt.

There is a canal for ships and a fish ladder for migrating fish although a number of species have died out because of a lack of oxygen.

The rapid raising of water level upon completion of the dam caused flooding up-river including low-lying areas of the city of Enconarnacion.

New housing had to be built for 40,000 people. The . Reservoir level is 22 feet (7 m.) lower than originally planned to avoid the displacement of 80,0000 additional people. There have been charges of corruption in the building of the dam. *(Yacyreta - Wikipedia)*

## THE ORIGIN OF MAN (1)

Studies of fossil remains of various *Homo species* have established at least 20 distinct species including *Homo sapiens* (modern man) and *Homo erectus* over a period of 7 million years. Natural phenomena have dictated the time span of any species. Actual dates of the presence of any specie are known only by the artifacts found and identified.

At the time of the great *Toba volcanic explosion* about 74,000 years ago, there were four (4) known species; *homo Sapiens*, *Homo Erectus*, *Homo Neanderthalans*, and *Homo floresiensis*, (a sub-pygmy branch of *Homo Erectus*).

*Homo Sapiens* was decimated by the Toba Volcanic Explosion, perhaps to only a few thousand, that survived, perhaps only in East Africa. By 40,000 years ago they had migrated to all parts of Asia, Africa, and Australia.

*Homo Neanderthalans* survived in greater numbers because they were better developed for the bitter cold that succeeded the Toba eruption. They lived in Europe during the Ice Ages. They lived in Europe from about 200,000 B.C. until about 30,000 B.C. when they disappeared. The latest dated fossils were found in Iberia.

*Homo Erectus (Homo Erectus Solensis)* survived in Java to the west of Toba and apparently certain parts of Asia. The last known artifacts of *Homo Erectus* dated to 50,000 years ago. This is actually a more sophisticated descendent of *Homo Erectus* (*Wikipedia – Homo erectus solensis*)

*Homo Floresiensis* was a 3-foot tall subspecies of *Homo Erectus*. The race was isolated on the island of Flores in Eastern Indonesia. Since Flores has always been an island, they crossed the water some time after their specie separated from *Homo Erectus* or of common origin as much as 900,000 years ago. Their long isolation on the island would cause them to become smaller. They were about 3 feet tall with a cranial capacity of about 1/4<sup>th</sup> that of modern man. A skeleton, found in a cave on Flores Island was little more than 12,000 years old. Natives of Flores and other islands speak of seeing tiny people.

(1) “*Toba Volcano*” *Human Evolution, Chapter 5. Internet, Volcanoes*

The above section, based on Chapter 5 of [Human Evolution](#), is available on the internet “*Volcanoes – Toba Volcano – Through the Bottleneck*”-



## CATAclySMIC EVENTS, PAST, PRESENT, AND FUTURE

Cataclysmic events may be classified in several ways; area that is affected, time lapse of development, and time of duration. The events that could destroy civilization or of a major part of the human race can be described as *Doomsday events*. First is a listing of events or developments of major impact.

Atomic War:

Desertification & Drought: *See section on weather*

Earthquakes,

Epidemic of Virus mutation or Bacterial Disease

Famine

Floods:

Global Warming

Hurricanes & Tornadoes

Ice Age

Meteorite

Population Explosion

Tsunamis:

*floods & earthquakes*

Volcanic Eruptions: (Alphabetic listing by mountains) 63

### ATOMIC WAR

*Atomic War:* Although no government in its right mind will ever use atomic weapons, the number of Intercontinental Ballistic Missiles already manufactured, plus the continued development of such weaponry by other nations, poses the threat of an accidental launching or launching by persons unknown, could well trigger a domino effect. The explosion of a number of hydrogen bombs would likely create an upper atmosphere darkening of the sky that would prevent the reception of sunlight for as much as a decade, enough to exterminate most life on earth, including man.

A special danger exists when the nations of the world battle for the remaining supplies of petroleum, food or other necessities for survival of civilization.. Approximately half of the oil available will have been used by about 2020. In 2008, the consumption of oil by India and China has gone up rapidly as they expand their economies.

### DESERTIFICATION AND DROUGHT

*Desertification & Drought:* Desertification and drought are, first of all, directly related to global weather. On a cyclical basis, *El Nino & La Nina* are found to affect weather conditions worldwide. Desertification is also related to over-grazing of vulnerable lands and the practice of using valuable humus as fuel in areas with no trees or other firewood is available. Over-population is a major cause of desertification. Changes in wind patterns have been responsible for climate changes that have caused desertification.

## EARTHQUAKES

*Earthquakes Earthquakes* are the direct result of movement of the earth's tectonic plates, which form fault lines (faults) as they move. A sudden release of tension between plates is called an earthquake. Faults may be concealed under many miles of earth so may not be easily detected.

### MAJOR EARTHQUAKES

(Basic list comes from "List of Natural Disasters –" *www.Wikipedia*)

#### AFGHANISTAN:

- 1997, Northern Afghanistan:** A quaking in February. killed 2,000 and a quake on May 30<sup>th</sup> killed at least 4,000.
- 2002, March 25, Nahrin:** A series of earthquakes, the strongest at 6.1 completely destroyed the city with a loss of 1,000 lives

#### ALGERIA:

- 2003, May 21,:** The epicenter of the 6.1 earthquake was 40 miles (65 km.) east of Algiers. Death toll was 2,200 people.

#### ARMENIA:

- 1988, Dec 7, Spitak:** Death Toll, 25,000. injured, 15,000 and 400,000 were left homeless.

#### AZERBAIJAN:

- 1607, Shemakha** Death toll, 80,000

#### Caucasia:

- 1667, Nov.:** Shenaka, killed 80,000 .

#### CHILE:

- 1939, Jan. 24,** razed 50,000 sq mi. (93,000 sq km.) and killing 30,000.
- 1960, May:** Magnitude 9.5 earthquake near the coast caused a tsunami that reached Hawaii, New Zealand and Japan. Death toll was 4,000-5,000.

#### CHINA:

- 1290, Sept5.:** Chih: Death Toll, 100,000.
- 1556, Jan. 23: Shaanxi; Death** toll, 830,000
- 1782, South Sea:** Tsunami (earthquake) killed 40,000.
- 1920. December 19, Ganzu Province:** Magnitude 7.8 earthquake killed 200,000.
- 1927, May 22, Xing:** Death toll, 200,000
- 1932, Dec 22, Gansu:** magnitude 7.8 earthquake. Death toll, 70,000.
- 1970, June 5, **magnitude 7.5 and killing 10,000.**

**1976, Tangshan:** It was the worst earthquake to hit China in 20<sup>th</sup> Century, devastating 20 sq miles. (32 sq km.) of the city and leaving 255,000 dead (official total). Actual death toll may have reached 655,000.

The Tancheng-Lujiang fault system of over 460 miles (740 km.) horizontal displacement system is located in Eastern China. It runs from the north bank of the Yangtze R. northward into Siberia. It is part of an intertwining faults 3,000 miles (5,000 km.) long.

The earthquakes , one of 7.8 magnitude and a parallel one of 7.6 magnitude, occurred within 18 hours of each other. (*SpiNet – 1976 Tangshan Earthquake*)

#### **EL SALVADOR:**

**2001, Jan 13:** Magnitude 7.7 earthquake set off landslides with 850 deaths and at least 100,000 homes destroyed.

#### **GUATEMALA:**

**1976, Feb 4, Guatemala:** Death toll, 23,000.

#### **INDIA:**

**1935, Quetta:** Death toll, 60,000

**1950, Aug 15: Assam:** Affected area, 10,000 sq mi. (78,000 sq km.) 1,500 killed.

**2001, Jan 26, Gujart:** magnitude 7.7 earthquake caused 20,000 deaths, and leaving 600,000 homeless.

**2005, Jan 26, Kashmir:** Death toll, 87,350

#### **INDONESIA:**

**2004, Dec. 26: Indian Ocean, Sumatra: (The Great Sumatra-Andaman Earthquake).** Magnitude 9.3, Richter. An earthquake in the ocean raised an area 10,000 ft deep 3,000 m, over 40 feet (12 m), causing a tsunami that inundated the shores of Sumatra, Thailand and other islands and countries bordering the Indian Ocean, reaching the coast of Africa hours later. The estimated death toll in the Indian ocean basin is 230,000.

The earthquake was unusually large in extent, extending about 1,000 miles (1,600 km.) in a fault between the India and the Burma plate as the India plate subducts beneath the Burma plate. The earthquake lasted 18 minutes. Most earthquakes are over within a minute. The tsunami generated waves as high as 100 feet (30 m.) and economic damage was in the high billions. Economic aid was pledged at 7 billion U.S. dollars. (*Indian Ocean Earthquake – Wikipedia*)

**2006, May 26, Java:** magnitude 6.7 earthquake killed 5,749 people and destroyed 127,000 homes.

#### **IRAN:**

**856, Dec., 22: Damghan,** Death toll, 200,000

**893, Mar. 23: Ardabil:** Death toll, 150,000.

- 1727, Nov. 15, Tabriz:** Death toll, 77,000.
- 1978, Sept. 16, Tabas:** City was destroyed, leaving 15,000 dead. The oasis city of 17,000 had 3 buildings still standing after a quake lasting only a few seconds. Of 100 villages with a 60 mile radius, 40 were leveled with an additional 10,000 deaths  
*("The Town that Disappeared" Time magazine, October 02, 1978.)*
- 1990, June 21, NW Iran:** Magnitude 7.7 earthquake. Destroyed cities, leaving 50,000 dead, over 60,000 injured and 400,000 were left homeless..
- 1997, May 6, NE Iran:** 7.6 earthquake left 1,500 killed and over 4,000 injured.
- 2003, Dec. 26, Bam:** 6.6 earthquake destroyed Bam, an ancient city, The death toll was 26,271 and 75,000 were left homeless.

#### ITALY:

- 1693, Jan. 11: Sicily:** Death toll, about 60,000.
- 1783, Feb 4, Caldaria:** A series of 6 earthquakes over 2 months, causing massive destruction and a death toll of 50,000.
- 1908, Dec. 28, Messina, Sicily:** Death toll, 70,000- 100,000op.
- 1915, Jan. 13, Avezzano:** Magnitude 7.5 earthquake killed 29,980.

#### JAPAN:

- 1701, Oct. 28:** Tsunami, caused by earthquake, drowned about 30,000.
- 1896, June 15:** Sanriku, earthquake and tidal wave killed 27,000.
- 1923, Sept. 1, Great Kanto:** Death Toll, 140,000. Many structures in Tokyo were damaged or destroyed.
- 1995, Jan. 17, (Hanshin Earthquake) Osaka, Kyoto and Kobe:** 6.6 earthquake with 5,500 killed and 38,000 injured. Kobe was particularly damaged.
- 2011, 11 March: Great Sendai Earthquake:** It was a 300 mile long slip in plate tectonics, with a magnitude of 9.0 Richter, accompanied by a tsunami about 60 feet high as it hit the shore of Honshu Island. It was one of the 5 strongest earthquakes in over a century. Damage was in excess of 2 to 3 00 billion including loss of 30% of Electrical production with destruction of 4 atomic reactors. Death toll is expected to reach 30,000..

#### MEXICO:

- 1985, Sept. 15, Mexico City:** Magnitude 8.0 earthquake devastated part of Mexico City and three coastal states, with an estimated 25,000 killed.

#### MOROCCO:

- 1960, Feb. 29, Agadir:** Most of city was destroyed by earthquake, tidal wave, and fire with death toll of 10,000-12,000.

#### NICARAGUA:

- 1972, Dec. 22, Managua:** Earthquake devastated the city and killed 6,000.

#### PAKISTAN:

- 1935 May 30, Quetta:** death toll 30,000-60,000.
- 2005, Oct. 8, Kashmir-Pakistan,** 7.6 earthquake, killing 80,000 people and injuring 65,000. Half the city of Muzaffarabad was destroyed as well as

many villages.. It took weeks for aid to reach many mountain villages.

**PERU:**

**1970, Ancash:** Death toll, 66,000:

**PHILIPPINES:**

**1976, Aug 15, MINDANAU:** Earthquake & tidal wave; 8,000 dead or missing.

**1990, July 10, n. Philippines:** magnitude 7.7 earthquake killed nearly 2,000.

**PORTUGAL:**

**1755, Nov 1, Lisbon:** Death Toll, 100,000.

**SYRIA:**

**1138, Aug. 9: Aleppo:** Death Toll, 230,000

**TAIWAN:**

**1999, Sept 21:** 7.7 magnitude earthquake killing 2,295 and injuring 8,729.

**TURKEY:**

**1939, Dec 27, Erzincan:** destroyed city with death Toll, 32,700.

**1999, Aug 17, NW Turkey:** Magnitude 7.6 earthquake killed 17,000 and injured over 44,000. Another 7.2 magnitude earthquake hit near Ducez, killing 700.

**TURKMENISTAN:**

**1948, Oct 5, Asgabat:** Death toll, 110,000

**UNITED STATES:**

**1811, Dec. 16:** Mississippi River valley near New Madrid, Mo. Sparse population kept the death toll low. There were three tremors, measuring about 8.0, 8.4, and 8.8 on the Richter scale.

**1886, Aug. 31:** Charleston, S.C. magnitude 7.3 Richter causing major damage and killing 60 people.

**1906, April 18:** San Francisco, Calif., It destroyed much of the city and caused the death of about 700-3,000 deaths.

**1933, March 10, Long Beech, Ca.** death toll was aa7.

**1964, March 28, Alaska)** magnitude, 9.2, strongest recorded earthquake in N. America. It hit 80 miles (115 km.) east of Anchorage, followed by a 50 foot high tsunami over 8,000 mi. (12,900 km.)

**1989, Dec. 7, San Francisco:** Magnitude 7.0 earthquake damaged infrastructure and killed or injured 3,000.

**1993, Aug 8, Guam:** Magnitude 8.1 earthquake cause considerable damage but no casualties.

**1994, June 17, San Fernando Valley:** magnitude 6.67 earthquake causing 61 deaths and between 13 & 20 billion dollars in damage.

## EPIDEMICS OF VIRUSES AND BACTERIA.

*Epidemic of Viral Mutation or Bacteria.* At the end of World War I, an epidemic of influenza killed millions world wide. A similar epidemic, considering the greater number of large cities and nearly 4 times the population, could kill a billion or more. Today, Avian Flu is watched worldwide with gravity. Flu is probably the most feared of diseases because of new strains that develop.

### CONTRACTABLE DISEASES

(Basic list comes from List of Natural Disasters” [www.Wikipedia](http://www.Wikipedia))

For description of diseases *Worldbook Medical Encyclopedi8th edition.*

**AIDS** is a slow growing virus, preventable and spread through body fluids:

From 1981 to present about 26 million people died.

### ANTONINE PLAGUE

160 to 185 A.D. It killed about 5 million people in the Roman Empire.

**BUBONIC PLAGUE** killed a total of 300 million people in three epidemics.

1200-1700 A.D. (Black Death) in Asia, Europe, Africa

540-590 A.D.. (Plague of Justinian), Asia, Europe, Africa

1850-1950 A.D.(Third Pandemic) worldwide.

### FLU, ASIAN (pandemic)

1957 A.D. It killed 4 million people Worldwide

### FLU, BIRD (HSN)

2000A.D>. to the present 250 known victims. . Only a few outside of Asia..

**FLU ASIATIC (RUSSIAN)** Death toll at least 250,000 in Western Europe

It was first reported in Russia in May, 1889. It hit North America in December,

1889. By February, 1890 it traveled to S. America. It later hit Asia and Australia.

1890. It had a high mortality rate.

### FLU, HONG KONG (pandemic)

1968 A.D. It killed 750,0000 people Worldwide

**FLU, SPANISH:** It was a flu, that probably began in the U.S.

1918-1919 A.D. causing the death of 20 to 100 million people.

**MALARIA:** It is present in all warm areas. It weakens those it does not kill

1900 to 2005 A.D. between 80,000,000 and 250,000,0000 people died.

**POLIO: 1952:** polio killed 3,000 in 1952 in the United States. A 1916 epidemic killed 6,000 It is still occurring in Africa.

### SARS (Severe Acute Respiratory Syndrome)

2002-2003 A.D. 775 known fatalities mostly in Middle East Asia.

**SMALLPOX 1492 to 1900** Epidemic among Native Americans. About 75 million

Ethnic Americans were alive in 1492. By 1900, there were less than 1,00. Major among the cause of the decline were smallpox epidemics for which they had little or no resistance. It is believed to be wiped out but it killed 300 million people in the 20<sup>th</sup> Century.

**TUBERCULOSIS:** New strains are difficult to cure and it is spreading worldwide.

From 1900 to 2005 A.D. it killed between 40 and 100 million. Worldwide.

**TYPHOID FEVER:** Bacterial infection, usually from food or drink contaminated by flies direct contamination from feces or urine. It is a member of the salmonella family. A high fever of up to 104 F (40 C) develops after an incubation period of about a week. It is treated with antibiotics. Serious side affects are pneumonia and ulcers of the small intestines that sometimes cause perforation and bleeding sometimes requiring surgery. It may be necessary to intravenously add fluids to prevent dehydration. The person must be tested after recovery to detect possible contamination. The disease needs medical care to avoid possible fatal infection

**TYPHUS:** Various epidemics, The bacteria are spread by body lice. As many as 9,000,000 died of typhus during World War I. Typhus epidemics have occurred periodically. The first outbreak that was reported was in Athens in 420 B.C.

**WEST NILE VIRUS** It is a virus spread by certain mosquitoes  
1999 to 2004 A.D. 677 known fatalities in North America.

## FAMINE

*Famine:* The primary cause of famine is weather. Basic factors include *poor* communication, poor transportation, war, overcrowding, and improper use of the land such as overgrazing. In much of Africa, weather patterns change and much of the continent is subject to desertification. Many parts of the continent have droughts that may last many years. Drought means famine in many countries. Blights, locusts, and other insects may reduce yields or destroy entire crops.

### MAJOR FAMINES

(basic figures come from “List of Natural Disasters” *www.Wikipedia*)

#### CHINA:

1876-1879 A.D.	Northern China Famine	13 million deaths
1907 A.D.	Chinese Famine of 1907	24 million deaths
1928-1930 A.D.	Chinese Famine of 28-30	3 million deaths
1936 A.D.	Chinese Famine of 1936	5 million deaths
1941 A.D.	Chinese Drought, 1941	3 million deaths
1958-1961 A.D..	Three difficult years	20-45 million. deaths

#### ETHIOPIA

1888 A.D.	Horn of Africa Famine	1 million deaths
1984 A.D..	Ethiopia Famine	1 million died

#### EUROPE:

1315-1317 A.D.	Great European Famine	7 1/2 million deaths
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#### INDIA:

1876-1879 A.D.	Southern Indian Famine	10 million deaths
1943 A.D.	Bengal Famine of 1943	1 to 3 million died

#### IRELAND

1846-1849 A.D.	Great Irish Famine	1.1 million died
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#### KOREA, NORTH

1996-1998 A.D.	North Korean Famine	1.2 million died
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#### UKRAINE:

1921-1922 A.D.	Ukraine Volga Famine	5 million deaths
1932-1934	Holodonor	5 million deaths

#### VIETNAM:

1943-1945 A.D.	Vietnam War Famine	2 million died
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#### WIDESPREAD

1898-1902 A.D.	Indian Famine	19 million deaths
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## MAJOR FLOODS

*Floods:* Floods have just two causes; rain and snow melt. Many of the worst floods have been the result of hurricanes that may bring 10 or more inches (25 cm) of rain to an area in a few hours. Many of China's great floods have been from heavy snow melt in the Himalayan mountains down the Yangtze River. Yellow River floods are not uncommon and come from rains in mountain areas.

### FLOODS AND LANDSLIDES

(Basic List is from ("*Floods and Landslides*" Wikipedia))

**If the source of a flood is a typhoon, hurricane or tornado, it may be included in that category)**

#### CHINA:

**1642, (4) Yellow River,** Death toll, 300,000.

**1887, (2) Yellow River (Huang He):** Death toll, between 900,000 and 2,000,000.

**1911, Yangtze River:** Death toll, 100,000.

**1931, (1) Yellow River (Huang He)** Death toll, between 1 and 3.7 million.

**1931 ((96) Yangtze River,** death toll, 145,000.

**1935, Yangtze River):** Death toll, 145,000.

**1938, (3) Yellow River,** Death Toll between 5,00,000 and 900,000.

**1954, Yangtze River:** Death toll, 30,000.

**1973, (5) Ru River (Banqiao Dam):** Death toll, 235,000.

#### DOMINICAN REPUBLIC & HAITI:

**2004:** Death toll, between 1,600 and 3,600. Spring flooding.

#### EUROPE, NORTH:

**1099 (7) North Sea,, Netherlands & England,** Death toll, 50,000/

**1287 (8) Zuider Zee, Netherlands,** Death toll, 50,000

**1362:Denmark, Germany, Netherlands:** Death toll, 35,000

**1421 (10) Zuider Zee,** Netherlands, failed sea wall, Death Toll, 10,000.

**1632, Germany, Denmark:** Death toll, 8,000.

#### INDIA:

**2005, Bombay & surrounding area:** Death toll, , 1,000.

#### IRAN:

**1954:** Death toll, 10,000.

#### ITALY:

**1903 Vagont Dam:** death toll, 1,900, landslide.

**PHILIPPINES:**

**2006, Leyte:** Death toll, 1,800, Southern Leyte, mudslide

**RUSSIA:**

**1824 (9) Neva River.** Death Toll, 10,000.

**THAILAND:**

2011: major flood of the Chao Phraya and Mekong Rivers. Damage so extensive it may result in Famine of much of Thailand. The floods lasted three months.

**UNITED KINGDOM:**

**1935,** Death toll, 2,142/ Storm surge, North Sea flood.

**UNITED STATES:**

**1889, Johnstown:** Death toll, 2,200.

**VENEZUELA:**

**1999, Vargas Mtns.:** death toll, 30 to 50 thousand.

**VIETNAM:**

**1977** Death toll, 100,000

## GLOBAL WARMING

*Global Warming* : The specter of global warming is familiar to virtually all governments of the World. The excessive burning of fossil fuel is pumping over 7 billion ton of carbon dioxide into the air each year. Half of that is being absorbed by the oceans. It is feared that the amount being absorbed by the seas will actually decrease as the seas warm up. It is estimated that Greenland is losing its icecap at a rate of 100 billion ton each year or about 1%. At the present time, the only certain way to stop global warming is to reduce the global use of fossil fuels by over 50%. It is quite likely that the reduction should be far more and this might be only a stopgap measure. Without further knowledge of variations in the output of heat by the sun, the parameters of the phenomenon are still doubtful, especially the time of no return when global warming might be self generating. A likely result of global warming in the short term is the proliferation of violent storms. The oceans have risen a foot in the last century. A further rise will force the evacuation of a number of Pacific and Indian Ocean island nations.

***Tropics, Expansion of the Tropical Belt:*** ““Changing Climate is causing earth’s tropical zones to expand toward the poles faster than estimates - -“ (1) . It is estimated that the tropics have expanded both toward the South and the North by nearly 100 miles (160 km) since 1975..

The widening of the tropics has several implications. The subtropical dry areas would include southern Australia, much of the area of southwest U.S. and northern Mexico, much of the heavily populated Mediterranean area, and southern Brazil and northern Argentina. (2)

Areas farther north would be subject to greater storm activity. (2)

Shifts in the pattern of tree growth have already been evident with zones of tree growth moving farther toward the poles. Polar areas are already warming because of the loss of highly reflective snow and ice fields.

A possible benefit of the tropical expansion would be the accompanying expansion of tropical rain belts, reversing the desertification of the Sahara Desert.

(1) “*Expanding tropics to send climate haywire*” ABC Science Online.

(2) *Ibid.*

## HURRICANES, CYCLONES, AND TYPHOONS

*Hurricanes & Tornadoes* Hurricanes begin as low pressure areas over very warm water, accompanied by hot winds off the desert, making it possible to store enormous energy as water evaporates and stores its energy in the air.

Tornadoes form as a warm front with extremely high humidity meets with a cold front that releases the energy of condensing vapor in the air.

### CYCLONES, TYPHOONS, AND HURRICANES

(Basic list comes from "List of Natural Disasters" *www.Wikipedia*)

Numbers in parentheses denote ranking among the worst storms on record.

#### BANGLADESH:

**1905, (cyclone):** Death toll, 30,000.

**1957, (hurricane) (2)** At least 300,000 people died

**1963 (9) (Hurricane)** Death Toll, 22,000.

**1965, (7) (Cyclone):** Death toll, 35,000 to 40,000.

**1970, jBhola Cyclone Lm** Death toll, 500,000.

(1) Deadliest hurricane in the last hundred years

**1991 (cyclone).** Death toll, 135,000.

#### BURMA - MYANMAR

#### CARRIBEAN:

**17880 (10) (hurricane):** At least 20,000 died in Barbados and Martinique. It also severely damaged the British Fleet, temporarily giving the French superiority at sea and leading to the British defeat at Yorktown.

#### CHINA:

**1912, (Typhoon)** Death toll, toll, 50,000.

**1922, (typhoon).** Death toll, 60,000. (Swatow Typhoon)

**1975, Banqiao Dam (super cyclone):** (also listed under floods) Death toll 229,000. Over 39 inches of rain (1 meter) in 3 days caused the failure of the Banqiao Dam and subsequently a total of 62 dams. Deaths were caused by drowning and, and death by famine and disease because of total loss of transportation and communication., d

#### HONDURAS:

**1998, (Hurricane):** Death toll: 18,277. Hurricane Mitch created a combination of flood and mudslides that destroyed bridges over 34 rivers and buried thousands of acres under mud. In 2007, the country had not completely recovered. Landmarks had disappeared and new roads and bridges had to be built.

#### HONG KONG:

**1906, (Typhoon):** Death toll: 10,000.

**INDIA:-**

- 1839, Cyclone:** Death toll, 300,000
- 1864, (6) (Calcutta Cyclone)** Death toll, 50,000 to 70,000.
- 1876 (4) (Hurricane) (Bengal) Death toll, 200,000.
- 1882 (5) Cyclone,** Bombay, Death Toll, at least 100,000.
- 1942. (8)(Cyclone:** Death toll, 35,000 to 40,000.
- 1977, (Cyclone):** Death toll, 20,000.

**MYANMAR:**

2008, May 2 : Cyclone Nargis, force 4. Death toll was officially 138,000 with total death toll probably over 200,000 from all causes. Over a million people lost crops and homes. In the delta of the Ayeyrwyady River

**PAKISTON:**

- 1963, (cyclone):** Death toll, 22,000.
- 1965, (Cyclone) Death** toll, 10,000.

**UNITED STATES:**

**1906 (Hurricane):** death toll, 8,0000. Virtually all property was destroyed on Galveston Island, Texas. It is .connected with mainland Texas by bridges.

**VIETNAM:**

- 1881, (3) (Heiphong Cyclone),** Death toll, 300,000.

**WEST INDIES:**

- 1780, Barbados, est.** Death toll, 22,000. Great Hurricane of 1780.

## ICE AGE

*Ice Age:* In the last 100,000 years there have been 4 major ice ages. Each one has caused a major disruption of animal life. The end of the last Ice Age saw a major shift in climate patterns. Among them was the change of a major part of the Sahara Desert from *steppe* to desert, causing the disruption of the peoples living in that area. Between the 12<sup>th</sup> and 19<sup>th</sup> centuries the World suffered the Little Ice Age. Many countries were forced to change from a grain crop livelihood to one of root crops. There was wholesale starvation in areas where the farmers failed to adapt to conditions. It is said that the French Revolution was a result of the failure of grain crops and the unwillingness of the French to change their diet.

A similar cooling off period would be a worldwide disaster because of the number of cities and countries in the temperate zones and their dependence of fossil fuels, a dependence that is creating problems today. A further complication would be in the number of sources of fossil fuel that would be hampered by a colder climate.

## METEORIC IMPACTS

*Meteorites:* Meteorites have caused the greatest long-term *cataclysmic* effects of all. Meteoric impacts leave craters of sizes depending on the size of the meteor and speed of entry. The impact will penetrate deep into the crust, far more than the size of the crater. There is a massive amount of debris fall out from the meteor and from the material in the crater. The potential of the energy is more than 100 million megatons, - -more than the world's entire arsenal of atomic and hydrogen bombs. (a) "The global effects of a large meteorite may be so devastating that scientist suspect they are the cause of many extinctions that have occurred in the Earth's history, including the death of the dinosaurs 65 million years ago" (a)

### Listing of known Meteorite impacts: (b)

- 2,020 million years ago: *Viedefort*, 180 miles (300 km.) diameter crater.  
Southwest of Johannesburg, South Africa,
- 1,844 million years ago: *Sudbury*, 125-mile diameter crater, complex  
Ontario, Canada, in the area of Sudbury, E of L. Superior
- 250-364 million years ago: *Woodleigh*, 37 miles (64 km.) diameter, complex  
South of Shark Bay and the town of Denham, Australia.
- 212 million years ago: *Manicouangan*, 60 mile (1100 km.) diameter crater, complex  
North of the Laurentian Mountains in northern Quebec, Canada
- 142 million years ago: *Gosses Bluff*, 14 miles (22 km) diameter. Complex  
Near Hermansburg, west of Alice Springs, Australia
- 74 million years ago: *Manson*, 25 mile (37 km.) diameter; complex  
Around the town of Manson, north of Des Moines, Iowa, U.S.A.
- 70 million years ago: *Kara and Ust K*, 50-75 miles (65-100 km.) diameter.  
Close to the Kara R., near the Kara Sea, in Siberia, Russia.
- 65 million years ago: *Chicxulub*, 100 miles (150 km) diameter, complex  
Centered on the town of Chixulub, buried in the Yucatan Peninsula, Mexico.
- 35 million years ago: *Chesapeake Bay*, 53 miles (85 km.) diameter crater.  
Beneath Chesapeake Bay on the Atlantic coast of U.S.A.
- 35 million years ago: *Popigai*, 62 miles (100 km.) diameter, complex  
Near the town of Popigai, east of the Popigai R. in Northern Siberia.
- 25 million years ago: *Haughton*, 15 mile diameter crater, complex  
Northwest Territory, Canada in the arctic region
- 15 million years ago: *Ries*, 15 mile (24 km.) diameter, complex  
Southern Bavaria, northwest of Munich.
- 1 million years ago: *Bosumtvi*, 6 miles (10 km.) diameter crater.  
Beneath Lake Bosumtvi, northwest of Accra, Ghana in W. Africa
- 50 thousand years ago: *Meteor Crater*,  $\frac{3}{4}$  mile (1.2 km.), diameter; simple crater.  
Painted Desert, East of Flagstaff, Arizona, U.S.A.
- 50 thousand years ago: *Lomar*, 1.1 miles (1.7 km.) Diameter; Simple crater.  
Northwest of Munnubu, in western India.
- 19008 A.D.: *Tunguska*, There is no known crater, one of Earth's mysteries.  
Near the Tunguska R. and in forests N. of Lake Baikal in Siberia.

## POPULATION EXPLOSION

The most insidious, yet catastrophic event is the 4-fold increase in world population between 1940 and 2040 (projected). The demand of fuels, foods, and all the other trappings of civilization are rapidly exhausting many of our resources and creating the dangers of global arming. The true catastrophe is that there is no humane solution. The earth can not long sustain this pressure of people. It can only multiply the effects of all other forms of cataclysm. We may well see the biblical "Armageddon" as people scramble over and destroy each other to get that last gallon of oil, that last lump of coal, that last scrap of food. Without fossil fuels the earth may be unable to sustain populations over 1-2 billion people, perhaps a stabilization at ½ billion.

*Population Explosion* A great number of nations, especially in Africa, are forecast to double their population before 2050 and the world population will increase by over 50% by 2050. This, in itself does not presage imminent disaster except for nations such as Bangladesh, directly since their land areas are already taxed to the maximum. The population pressure in Haiti, Dominican Republic and Central America is making itself felt as a million or more people cross the U.S. Mexican border each year without suitable permission from the U.S. government.



## VOLCANIC ERUPTIONS

*Volcanic Eruption:* The eruption of Tambora in 1815 caused a year without a summer in 1816 because of the large amount of fine debris that was suspended in the upper air for more than a year. A similar eruption in 2007 would cause global chaos and the possible starvation of many million people. Crops in the United States and Canada would be a fraction of normal production. A similar experience would occur in northern Eurasia and in the grain-growing areas of the Southern Hemisphere. Worldwide stocks of grains would be quite insufficient. Other economic impacts are not estimable.

Late surveys of the world indicate the presence of upwards of a hundred *super volcanoes*. Most of these volcanoes rarely erupt but their eruptions are so violent that no typical volcanic cone is developed. Yellowstone Caldera Complex is an example of the super volcano. Its last cataclysmic eruption was about 660,000 years ago. 400 miles (640 km) from the volcano, the ash was over 4 feet (1 m) deep. It is estimated that only a small number of the species *Homo* survived. This was also true of most other land species. An area of about a thousand miles radius was totally devastated.

## MAJOR ERUPTIONS

**COTOPAXI:** Ecuador, north-central

1877, June 28: Eruption caused several mudflows that wiped out surrounding cities and valleys with about 1,000 deaths.

### ETNA

**KRAKATAU:** Indonesia, Island between Java and Sumatra.

1883, August 26-28: Explosions destroyed two-thirds of the island and caused a tsunami that hit Java and Sumatra, killing more than 36,000 people. The explosion was felt as far away as Cape Horn.

**NEVADA DEL RUIZ::** Colombia, 80 miles North of Bogotá.

1985, September 19: Eruption caused mudslides, burying several cities and killing 21,000 people.

**PELEE, MOUNT:** Martinique, West Indies

1902, May 8: Eruption wiped out the city of St. Pierre, with a death toll of 40,000.

**PINATUBO:** Philippines, Island of Luzon

1991, July 15: Eruption buried over 300 square miles (775 sq. km.) in volcanic ash and 600 dead. Subsequent rains have caused floods of mud and burying farms and villages with an unknown number of deaths.

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**SOUFFRIERE:** Saint Vincent, West Indies  
1902, May 7: Eruption destroyed more than one-third of the island, killing 1,688 people.<sup>11</sup>

**SOUFRIE HILLS:** southern Montserrat  
1997, June-September: Major eruption caused abandonment of much of the island

**TAMBORA:** Indonesia, Sumbawa  
1815, April 5, 10-11: (Rhyolite Caldera Complex) Largest eruption in recorded history. About 82,000 people were killed by explosion. Ash, suspended in the stratosphere, created a cloud that resulted in the year(1816) without a summer. Worldwide famines, especially in north latitudes, were caused by crop failures and hypothermia. It was reported that there were long icicles in July on buildings in the Northern United States.

**TOBA:** Indonesia, Sumatra  
73-75,000 years ago, the *Rhyolite Caldera Complex* volcano, Toba, exploded, discharging about 670 cubic mile(2,800 cubic km) of material. It was many decades before the sky was clear. It is estimated that the eruption was followed by up to 100 years of unusually cold weather. The caldera collapse after the eruption formed a lake about 19 x 60 miles (100 x 30 km). A later pressure bulge formed an island in the lake. See also "Lake Toba". *Wikipedia, Toba Volcano*.

**UNZEN:** Japan, Kyushu Island  
1792, May 21: Collapse of old lava dome during an eruption with avalanche and tsunami, About 14,300 people were killed, most by drowning.

**VESUVIUS,** mount Italy, Naples  
**56 A.D.** Eruption destroyed Pompeii and Herculaneum The cities were completely buried for eighteen centuries.

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(a) *Earth, Smithsonian*, p 121

(b) *Ibid.* pp 122-125.

## ARTICLES OF FURTHER INTEREST

The following are excerpts from articles in various periodicals, which the reader is encouraged to read. Most libraries have collections of these periodicals. There may be a few quotes from other sources with suitable recommendations.

### AFGGHANISTAN (excerpts)

*National Geographic*, February, 2002. "Afghanistan" pp112-113

King Mohammed Zahr Shah established a democracy with the cooperation of many warlords. Women were encouraged to wear Western dress and many enrolled in the University. Many reforms were supported by the U.S. and other nations. Many road building and irrigation projects were built. The Soviets built apartment buildings and trained the Army. In 1973, Zahr was overthrown by a cousin, Daoud, who abolished the parliament. He, in turn, was assassinated by the Communists, who were unable to hold power without assistance from the Soviet Union. Thus began 23 years of terror and war.

### ALBANIA: (excerpts)

*National Geographic*: February, 2000, "Albania, A People Undone." Pp 53-83.

The needs are still urgent and many villages are in ruins. The seaport of Vlore is major transit port for illegal drugs, and the Mafiosi is active.

Kosovo, with 2 million people, is 90% Albanian. In 1998-9. Serbian art cities increased as Serbs tried to curb freedom that Kosovo enjoyed under communist rule. The NATO forces entered Kosovo to stop Serbian activity.

### BANGLADESH: (excerpts)

*National Geographic*: June, 1993, "When the Water Comes"

In 1998, a combination of a flood from an extremely large snow melt from the mountains, monsoon rains, and a cyclone, flooded 2/3 of Bangladesh for 6 weeks. Much of Bangladesh lie on a flood plain at the estuary of a river formed by three great rivers. The rivers flood annually, covering one-fifth of the country and enriching the soil with two billion ton of silt each year, changing the map as chars (silt-formed islands) build up and eventually wash away. The silt forms a myriad of islands, which are farmed. The farmers are homeless and shift places to farm even as the islands form or disappear. Periodically, cyclones form in the Indian Ocean causing great storm surges, flooding islands along the Ocean shore and in the flood plain, drowning many thousands. Hundreds of concrete havens are now being built on the islands along the ocean shore. Those who live on chars can only hope to be warned in time to flee to higher ground.

BHUTAN: (excerpts)

*National Geographic*: May, 1994, (pp 79ff) “Kingdom in the Clouds”

Some progress has been made but resources remain largely undeveloped. People are regulated as to dress and manner of deportment. Close ties are being developed with India.

BOSNIA-HERGOVENA: (excerpts)

*National Geographic*: July, 1996, (pp 48-60) “Bosnia” (see also Yugoslavia)

In 1991, Slobodan Malosovic attempted to set up Serbia as the ruling country over the other 5 Balkan states. Bosnia was one of the 4 that declared independence. The *ethnic cleansing* and war waged by Serbia against Bosnia resulted in the deaths of many thousand Muslims and 60% of all homes in Bosnia being damaged or destroyed. More than a million land mines are scattered throughout the countryside. United Nations intervention stopped the killing. Today it is an uneasy republic with many factions harboring old grievances against each other. Divisions are more or less classified according to religious beliefs. There can be no clear division because the mix of factions in country-wide.

CONGO (ZAIRE) (excerpts from Television Broadcast)

*CNN* (cable television) documentary on 6 October, 2006

It was a report on the rape and killing of thousands of civilians in the province of Doufor and of the forced flight of many thousands into Chad. Thousands were reported to have been raped and many children seriously injured or killed by troops and sanctioned gangs.

CROATIA: (excerpts)

*National Geographic*: June, 1996. (p 51) “Bosnia” (see Yugoslavia)

“Secession in June, 1991, unleashed a savage response from Belgrade, which was sympathetic to Croatia’s large Serbian minority. The district of Eastern Slavonia is under U.N. supervision.”

EGYPT: (excerpts)

*National Geographic*: January, 1997 “It happened in the Nile Delta”

The High Aswan Dam saved many lives because it prevented disastrous floods. It also produced valuable hydropower for Egypt. The downside is that the Nile Delta, the major productive agricultural land for Egypt, is suffering from pollution and is slowly sinking into the Mediterranean Sea. In addition, the action of storm waves is eroding valuable land from the shore. The annual Nile flooding renewed the soil and flushed out the many tributaries that now lie stagnant. The government has failed to deal with sewage nor has it regulated industrial pollution. The city of Alexandria, which is built on the Delta, is surrounded by canals that are stagnant and plugged with raw sewage. Ninety-eight percent of the silt that once reached the Delta, now is forming at the head of Lake Nasser, the reservoir for the High Aswan Dam.

#### EL SALVADOR (excerpts)

*National Geographic*: September, 1995 (pp 108 ff)

In 1931, a Junta, led by Duarte, led an insurrection in which 62,000 lives were lost. The republic was toppled in 1932. During the rule by Duarte, the landed gentry expanded their holdings and the peasants were little more than serfs. In 1968, a number of groups, including the communists, revolted. The Junta was defeated in 1981 and an election, overseen by the U.N, and the republic was reestablished. Since then, much of the land has been parceled to the peasants. The tropical forests are virtually gone but some effort is being made to replant forests in land that is seriously eroded by tropical rains.

#### ERITREA (excerpts)

*National Geographic*: June, 1990, (pp 85-105) "Eritrea Wins its Peace"

#### KAZAKHSTAN

*New York Times*, Aug., 28, 2007 page c-3

The discovery of the largest field since the discovery of oil in Alaska in the 1960s has put Kazakhstan in an excellent position for export. The discovery is under the Caspian Sea. A number of oil companies have signed agreements for exploration. The Prime Minister has put all agreements on hold until the oil companies award Kazakhstan more favorable terms. The Prime Minister is virtual dictator of the country. Validity of future contracts is questionable so long as the government chooses to arbitrarily suspend agreements.

## WORLD LEADERS

A country is known for its strength and weaknesses. The extent to which these factors are utilized is often dependent on the leaders of these countries. Below is a listing of countries in which the leaders play a special part. In February, 2007 the "Parade" magazine listed the 20 worst dictators in the prior year and their rating as worst dictator of the year. The # after the name will indicate their rank. (#1 dictator) would indicate he was the worst. There were more than 70 countries ruled by dictators in 2006.

BELARUS: (Dictator) Aleksandr Lukashenka (Age 52) He has been in power since 1994.

CAMEROON: (Dictator) Paul Biya (Age 73) He has been in power since 1992

CHINA: (Dictator) Hu Jintao (age 64) Among human rights violations are torture, forced abortion, forced labor, detention of religious groups, and executions for such crimes as bribery and stealing.

EGYPT: (Dictator) Hosni Mubarak (Age 78) He has been in power since 1981.

ERITREA (Dictator) Isayas Afewerki (Age 61) He has been in power since 1991.

EQUATORIAL GUINEA: (Dictator) Teodoro Nguema (Age 64) He has been in power since 1971. The country has done poorly under his regime, which has been known, for corruption.

ETHIOPIA: (Dictator) Meles Zenawi (Age 51) He has been in power since 1995.

IRAN: (Dictator) Sayid Al Khamenei (age 67) He and the 12 man guardian council pass on all rules and continue the stifling of self-expression. Women can be stoned to death for adultery. Human rights for women are strictly limited.

KAZAKHSTAN: (prime Minister with great executive power) Nursultan Nazarbayev

LAOS: (Dictator) Choummaly Sayasone (Age 70) He has been in power since 2000.

LIBYA: (Dictator) Muammar Al-Qaddafi ((Age 64) He has ruled Libya for 38 years. He was known for openly sponsoring terrorism. His apparent reform has meant large oil revenues. His control of the country has not relaxed and human rights violations continue.

MYANMAR (BURMA): (Dictator) (Than Shwe (Age 74) After 17 years of Promises, a new Constitution has not been activated. The media is under strict control and Myanmar continues to be isolated.

NORTH KOREA: (Dictator) Kim Jong-Il (age 64) His domestic human rights abuses. His concentration on building an armed force has pauperized the people

PAKISTAN: (Dictator) Pervez Musharraf (Age 63. He has been in power since 1999.

RUSSIA: (Dictator) Vladimir Putin (Age 54) He has been in power since 1999.

SAUDI ARABIA: (Dictator) King Abdullah (Age 83) Under his regime, it is legal to execute a person for witchcraft and flogged for being with an unrelated person of the opposite sex. Textbooks are wholly anti-Christian and anti-Semitic. Large segments of the population receive little benefit from oil revenues.

SUDAN: (Dictator) Omar Al-Bashir (age 63) He is known for deadly human rights abuses. In the Darfur region. At least 20,000 people lost their lives, and, nationally, over 5.3 million have been driven from their homes..

SWAZILAND: (Dictator) King Mswati III (Age 39) He has been in power since 1986.

SYRIA: (Dictator) Bashar Al-Assad (Age 41) He assumed control after his father resigned. His administration has been implicated in assassination and human rights violations.

UZBEKISTAN: (Dictator) Islam Karimov (Age 69) He was the top official when the Soviets ruled Uzbekistan. Using Soviet tactics, he attained power and now controls the media and, through dummy elections, is well established. His regime is known for human rights violations.

ZIMBABWE: (Dictator) Robert Mugabe (Age 82) Under his rule, Zimbabwe has continued to decline in life expectancy, general health and in human rights. Life expectancy is now 37 for men and 34 for women, and 20% of all children are orphans.

(N)

## WEIGHTS & MEASURES

	Length	Weights	
1 Centimeter	= .3937 inch	1 gram	0.03527 ounces
1 inch	= 2.5400 centimeters	1 ounce	28.3495 grams
1 foot	= .3048 meters	1 kilogram	2.2046 pounds
1 meter	= 3.2808 feet	1 pound	0.45359 kilogram
1 meter	= 1.0936 yards		
1 yard	= .9144 meters		
1 kilometer	= .6214 miles		
1 kilometer	= 3281 feet		
1 mile	= 1.6093 kilometers		

	Area
1 sq centimeter	0.1550 sq inches
1 sq inch	6.452 sq centimeters
1 sq meter	1.1960 sq yards
1 sq foot	0.0929 sq meter
1 sq kilometer	0.3861 sq miles
1 sq mile	2,590 sq kilometers

	Volume
1 quart	0.946 Liter
1 gallon	3.765 Liter
1 acre foot	1,234.5 cu meters
1 cubic centimeter	0.0161 cubic inches
1 cubic inch	16.3872 cubic centimeters
1 cubic meter	35.314 cubic feet
1 cubic foot	0.02832 cubic meters
1 cubic foot	7.48 gallons
1 cubic meter	1.3078 cubic yards
1 cubic yard	0.7646 cubic meters
1 cubic yard	202 gallons
1 cubic liter	264.156 gallons
1 cubic km.	0,23995 cu. mile
1 cubic mile	4.1655 cubic km.



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