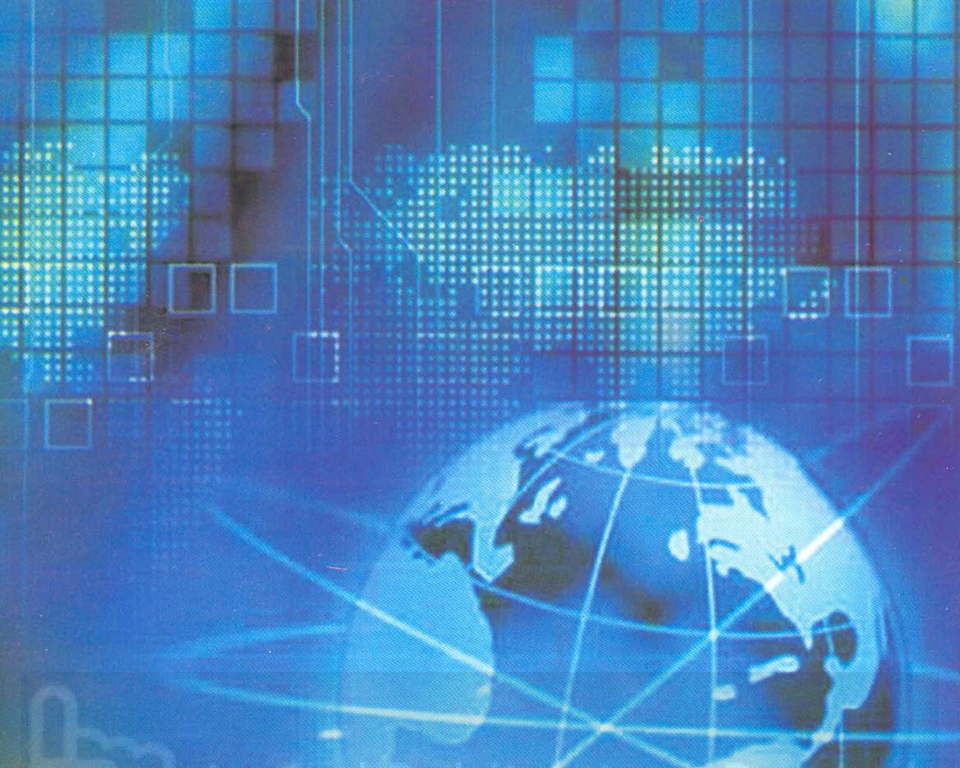

World Geography

A.M. BAGULIA

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Contents

Preface

The study of earth and all that relate to it in terms of flora and fauna plus all that pertain to its inside-outside is called Geography. Among various subjects of study, the formation and structure or shape of earth is of the greatest interest.

Since the 'Big Explosion', popularly known as the 'Big Bang', theories have come in thousands of numbers, talking about the shape and various aspects of the most opulent and rich planet, with reference to life-supporting resources of the solar system. But the most approved-of concept, regarding the shape of the earth is that it is ball-like.

Metaphorically, this 'Big Ball' has multiple layers in its bosom, very similar to an onion. These strata are called: crust (floor or surface), upper mantle, lower mantle, outer core and inner core.

Born approximately forty five crore years back, our beloved earth has an area of fifty crore and ninety six lakh square kilometres. Having a 4500°C temperature at its inner core, its outermost crust is pervaded by a number of gases including oxygen with the maximum proportion of 46.6% —a life-line.

Of all these important facts, we are here, exclusively concerned with the part, forming its outermost layer. Divided between the two, the facial stratum comprises land and water.

For ease, this land area has further been divided into seven regions, called continents. They are : (1) Asia, (2) Europe, (3) Africa, (4) North America, (5) South America, (6) Oceania, (7) Antarctica.

That way, the part of earth, we belong to, is Asia. Furthermore, India falls under South Asia, one of the most sensitive and interest-gravitating sphere in the global geography.

Public and private libraries possess stacks of books and encyclopaedia on this subject though, the undersigned has been perpetually under the weight of hovering ideas and thoughts of such a compact, exclusive and comprehensive work as may address any issues, whatsoever in connection with Geography.

Here is that unique book, nay, a series of semi-text books in your service for your ready reference. Knit neatly and prepared with every possible precaution to not let any minor error creep into its fabrication, this elegant piece of work includes five books, dealing with : (1) Physical Geography, (2) Economic Geography, (3) World Geography, (4) Indian Geography, (5) Practical Geography.

I feel proud of dedicating this beautiful series to my beloved motherland, India.

Henceforward, begins your duty; cherish and relish it word-by-word and acknowledge me with your honest feedback.

— Editor

1

The Universe

Planets and Stars

Galaxy : According to astronomers, there exist some 60-90 billion galaxies in the universe. Larger galaxies may contain up to one trillion stars while the smallest may have about a million. Our knowledge is limited to only two galaxies.

One, the Milky Way, of which our solar system is a part and the other one, visible to naked eyes, is Andromeda. Light year is the distance travelled by light in one year at a speed of 2,99,792.5 km. per second.

Galaxies : These are huge congregations of stars that are held together by force of gravity. Our Earth and the Solar System are contained in the Galaxy called Milky Way.

Stars : Stars account for 98 per cent of the matter in a galaxy. The stars nearest to the earth are Proxinta Centauri, Alpha Centauri, Barnard's Star, Sirius and so on. Of these, Sirius, is the brightest.

Solar System : The solar system is centered around the sun. There are nine planets in the system. They are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. There are 33 satellites and many asteroids and comets in the solar system.

The sun, which is one of the stars in the Milky Way, is composed mainly of hydrogen. The sun consists of the Photosphere, the Chromosphere and Corona. The age of the sun is about 5 billion years. Its diameter is 13,92,000 km. It is about 149.8 million kms away from the earth. Mercury is the smallest planet and the nearest to sun. It is the only planet without a satellite. Jupiter is the largest planet. It has 14 satellites. Saturn is most remarkable due to a system of rings which surround it. It has 10 satellites. It is the only outer planet visible from the earth. Venus is the planet which is closest to the earth. It is the brightest object in the sky, apart from the sun and moon. It is called the evening star. The Moon is the only satellite of the earth.

The Planets and the Moons : Our solar system comprises the sun, the planets and their moons. It also consists of several thousand minor planets called asteroids or planetoids and a large number of comets. In order of their distance from the sun, the planets of the solar system are : Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. Mercury and Venus are nearer to the sun than the earth. It requires much less time to pass between the earth and the sun than around the far side of the sun.

The temperature found on each planet depends upon its distance from the sun. The closer the planet to the sun, the higher is its temperature. It is believed that the universe began its existence some 15 billion years ago. At that time, it comprised hydrogen and a small amount of helium. There were neither planets nor stars. The sun seems to have been formed 4.6 billion years ago. Many stars appeared before the sun was formed and many more followed the sun's formation. The process of formation of stars still continues. Being combustible, stars have limited life spans.

Sun : Sun is considered to be parent of our solar system. It is also the largest member of the solar system. Every member of the solar system revolves around the sun. The sun is made up of extremely hot gases. It gives huge flames. It is the only source of heat and light for the entire solar system. The average distance of the sun from the earth is 14,95,97,000 km. and its equatorial diameter is 13,92,520 km. and its surface is approximately 12,000 times that of the earth. Its rotation period is 25 days, 9 hours and 7 minutes. Sun's rays travel at a tremendous speed of about 3,00,000 km. per second and take eight minutes to reach the earth.

Mercury : Mercury is the closest planet to the sun. It is the second smallest of the nine planets orbiting the sun at an average distance of 5,79,09,100 km. Its diameter is 4,878 km. and its period of revolution is about 88 days. The planet rotates on its axis in a period of 58 days, 15 hours, 36 minutes. Being nearest to the sun, Mercury receives the greatest amount of heat from it.

Venus : Venus is the brightest of all the planets and is slightly smaller than the earth. Its diameter is 12,102 km. It is at a distance of 10,82,08,900 km from the sun. It rotates very slowly in a clockwise direction, i.e., contrary to the spin of other planets and this rotational period is 244 days. It revolves round the sun in about 224 days. The picture sent by Russian probes show rocks strewn on the surface of this planet.

Mars : Mars is the first planet beyond earth. Its equatorial diameter is 6,794 km. and polar diameter 6,752 km. It is 22,79,40,500 km. away from the sun. Moving at a speed of about 25 kms. per second, Mars completes one revolution around the sun in about 687 days. It rotates on its axis in 24 hours, 37 minutes and 22 seconds, i.e., almost the same period of time as taken by the earth. Picture sent back by Mariner-9 probes in 1971-72 have shown that Mars is a world of mountains, craters and giant volcanoes.

Jupiter : Jupiter with an equatorial diameter of 1,42,880 km. and a polar diameter of 1,33,540 km. is the largest planet of our solar system. Its outer layers are gaseous, composed of hydrogen and hydrogen compounds. Jupiter's rate of rotation is rapid and it completes one rotation in 9 hours, 55 minutes and 30 seconds. Jupiter revolves round the sun, once in about 12 years. Jupiter is said to have 16 satellites, fourteen of which have been found through earth based observations.

Saturn : Second in size after Jupiter, Saturn is about 1,42,69,78,000 kms. away from the sun. Its equatorial diameter is 1,06,900 km. It takes 10 hours and 30 minutes to complete one rotation. It revolves round the sun in 10,759.06 days (about 30 years). Saturn is less dense but colder than Jupiter. Its specific gravity is less than that of water. Until Pioneer 11 passed Saturn in September 1979, only 10 satellites of Saturn were known. Since that time, the situation is quite confused. It is now believed that Saturn has at least 22 satellites. Voyager I and II would help sort out the confusion. Saturn was first discovered by Galileo.

Uranus : Uranus is believed to be similar to Saturn and Jupiter and has the same density as that of Jupiter. Its equatorial diameter is 51,400 km and polar diameter 50,300 kms, i.e., nearly four times that of earth. It is at a distance of 2,87,09,91,000 km. from the sun. It rotates on its axis in 17 hours and 14 minutes and revolves round the sun in 30,707.79 days (about 84 years). It is believed that Uranus is a grim frozen world. Uranus has five known satellites. It was discovered by Sir William Herschel on March 13,1781.

Neptune : Neptune too is believed to be similar, to Saturn and Jupiter. It has an equatorial diameter of 48,600 km. and a polar diameter of 47,500 km. It is at a distance of 4,49,70,70,000 km. away from the sun and takes 60,19,963 days (nearly 165 years) to make one revolution of the sun. The period of its rotation is 16 hours and 27 minutes. Neptune has three satellites, the third having been found in 1981.

Pluto : Pluto is the smallest and coldest planet of our solar system because it is remotest from the Sun. It has a diameter of 3,000 km. and rotates on its axis in 6 days, 9 hours and 18 minutes. Its mean distance from the sun is 5,91,35,10,000 km. and its period of revolution is 248.54 years.

Planets at a Glance

Name of the Planet	*Time Taken to Complete One Rotation*	*Time of One Revolution Around the Sun*
Mercury	58 days 15 h 36 m	88 days
Venus	244 days	224 days
Earth	23 h 56 m 4.2 s	365.25 days
Mars	24 h 37 m 22 s	687 days
Jupiter	9 h 55 m 30 s	12 years
Saturn	10 h 30 m	29.5 years
Uranus	17 h 14 m	84 years
Neptune	16 h 7 m	165 years
Pluto	6 days 9 h 18 m	248 years

h = hour; m = minute; s = second

In solar system, the earth is the third nearest planet from the sun and is the fifth largest planet. It has an equatorial diameter of 12,756 kms and a polar diameter of 12,714 kms. The earth is at a distance of 14,95,97,900 kms. from the sun and orbits round the sun at a speed of 1,07,220 km. per hour, making one revolution in 365 days, 5 hours, 48 minutes and 45.51 seconds. It completes, one rotation on its axis every 23 hours, 56 minutes and 4.2 seconds. The earth is a unique planet. It is a bit pear-shaped rather than a true sphere. The earth is considered to be a solid, rigid mass with a dense core of magnetic, probably metallic material. It is the only planet containing ample water and air around it. The temperature on the earth is also suitable for human life. The earth is spherical in shape, a little flattened at the poles. It is the third nearest planet from the sun. It moves in an elliptical orbit around the sun. The Earth completes one revolution around the sun in 365¼ days.

The age of the earth is estimated to be around 4.6 billion years. Its total area is 31,51,20,000 sq. km and nearly three-fourths of the same is covered by water.

Dimensions of the Earth

Mass	5.882 x 10^{21} tons.
Density	5.517 times that of water.
	1,08,32,08, 840.000 cubic km.
Equatorial Circumference	40,075.03 km.
Polar or Meridian Circumference	40,007.89 km.
Polar Diameter	12,714 km.

Shape : The following reasons show the earth to be an oblate spheroid (a ball flattened at the poles) (1) The Shadow of earth projected on the moon at the time of lunar eclipse is curved. (2) The timing of sunrise and sunset change, in direct proportion to the distance from east to west. (3) An air flight at a fixed height above sea level round the earth over the circumference passing through the poles would reveal less mileage than a flight round the equator. (4) Photographs of the earth taken from the moon by astronauts have confirmed the oblate spheroid shape of the earth.

Reasons for Flattening of the Poles : The high speed spinning of the earth around its axis has caused its mass to bulge out at the equator and sink in at the poles. The phenomena must have occurred during the formative period of the earth when it was in a semi-molten state.

Land and Sea Surface : The estimated total surface area of the earth is 51,00,66,100 sq. km. of which the sea or hydrosphere covers five-sevenths or more accurately, 70.92 per cent and the land or lithosphere the remaining two-sevenths or 29.8 per cent. The mean depth of the hydrosphere is 3,554 metres.

Earth's Motions : Earth's axis is an imaginary line which runs right across and passes through the centre of the earth. The earth spins round its axis which always remains inclined at an angle of 66½° to the plane of earth's orbit.

Rotation : It is the spinning of the earth on its axis. The earth rotates from west to east and takes 23 hours, 56 minutes and 4.091 seconds to complete one rotation.

At the Equator : There is 12 hour day and 12 hour night. North of 66½°, there is continuous day-light; south of 66½, there is continuous night. Days become longer with increasing latitude due north; shorter with increasing latitude due south.

Revolution : It is the movement of the earth around the sun 'simultaneously with its rotation. It takes 365 days, 5 hours, 48 minutes and 45.51 seconds for it to complete one revolution.

Orbit : It is the elliptical path of earth's revolution round the sun.

Perihelion : It is the nearest point to the sun. The earth reaches its perihelion in the beginning of January.

Aphelion : It is the point in earth's or other planet's orbit which is farthest from the sun. The earth reaches its aphelion in the end of June.

Leap Year : It is the year in which the month of February has 29 days. Leap year occurs once in four years. Earth actually takes 365 days, 5 hours, 48 minutes and 45.51 seconds to complete one revolution round the sun. For the sake of convenience, the year has been rounded off to 365 days. The remaining one-fourth of the day has to be accounted for, as a year represents the time taken by earth to complete one revolution round the sun. Therefore, once in four years one day is added to the year in the month of February, thus making it a leap year, for the sake of convenience, leap year has also been reckoned as the year divisible by four. For example the years, 1992, 1996, 2000, and so on, are leap years.

Solstice : It is the date on which the sun shines vertically over a tropic. On June 21, the sun shines vertically on the Tropic of Cancer and this date is termed as summer solstice for northern hemisphere and winter solstice for the southern hemisphere. Similarly, on December 22, the sun shines vertically on the Tropic of Capricorn. Hence, this date is summer solstice for the southern hemisphere and winter solstice for the northern hemisphere.

Equinox : It means equal nights (aquas = equal; nox = night). It is the period when sun inevitably shines vertically over the equator at noon, making the duration of days and nights of the same span of the period, i.e., twelve hours for a day and twelve hours for a night. March 21 and September 23, when days and nights are of equal duration throughout the globe, are called equinoxes. March 21 is called vernal equinox and September 23 is called autumnal equinox.

Light Year : It is an astronomical measure of distance, i.e. the distance travelled by light in one year. It is equal to $94,605 \times 10^{15}$ metres.

Moon : Moon is the only natural satellite of the earth. It is also the nearest neighbour of the earth at a mean distance of 3,84,400 km. centre to centre and 3,76,284 km. surface to surface. Its diameter is 3,475 km.

Change of Seasons : The inclination of earth's axis by 66½^{o} and earth's revolution round the sun bring about changing seasons. The two hemispheres experience summer when they are closer to the sun and winter when farther and away from it.

2

The World

Contemporary World

Significant Facts

Population : Quite alarmingly, the world's population is increasing by more than 96 million persons annually. According to the United Nations statistics, the world's population was estimated at 5.8 billion in 1997 and it rose to 6.2 billion in 2002. It was estimated to be 8.5 billion by 2025. In 1950, the figure was 2.5 billion. As per UN sources, the total world population was 4.478 billion in 1980, 4.577 billion in 1981, 4.640 billion in 1982, 4.722 billion in 1983, 4.942 billion in 1986, 5.128 billion in 1988, 5.234 billion in 1989, 5.333 billion in 1990 and 5.385 billion in 1991. The daily increase in the world's population has been estimated at about 2,63,000 or 182 per minute. It was estimated that 286 children were born and 114 persons died every minute in 1977-78. World population is currently growing by 96 million people every year. Projections issued by the UN Population Fund have estimated that the population would stabilise at around 11.6 billion around the year 2150.

Least Populous Country : The independent state with the smallest population is the Vatican City or the Holy See, with 1800 inhabitants in 1993 and a nil birth rate.

Most Densely Populated Territory : The most densely populated territory in the world is the Chinese province of Macau on the southern coast of China. It has an estimated population of 3,78,000 (mid-1993 estimates) in an area of 18 square kms giving a density of 21,000 per square kilometres.

Number of Countries : The world comprises 191 sovereign countries and 65 non-sovereign or other territories (dependencies of sovereign states, territories claimed in Antarctica and disputed territories), making a total of 256 nations.

Largest Country : The country with the largest area is Russia, with a total area of 1,70,75,000 sq. km., or 11.5 percent of the world's total land area. It is 70 times larger than U.K., with a population in 1992 of 149.47 million has only 2.6 times more people than those in the U.K.

Smallest Country : The smallest independent country in the world is the City of Holy See, which was made as an enclave within the city of Rome, Italy on February 11, 1929. The enclave has an area of 0.44 sq. km.

Smallest Republic : The world's smallest republic is Nauru, less than one degree south of the equator in the Western Pacific, which became independent on January 31, 1968. It has an area of 21 sq. kms. and a population of 9,060 (latest estimate 1992).

Most Populous City : The most populous urban agglomeration in the world is the Mexico City, which was listed in the United Nations Prospects of World Urbanisation 1990, as having a population of 2,02,00,000. By 2000, this is expected to increase to 2,56,00,000. Tokyo-Yokohama, Japan which until the late 1980s was the most populous is expected to decline to third place in the list by the turn of this century, with Sao Paulo in Brazil, likely to be the second.

Largest City : The world's largest city, in area, is Mount Isa, Queensland, Australia, which has an administered area of 41,225 square kilometres.

Highly Densely Populated Nations of the World (2002)

Nations	*Persons sq. km*
Singapore	6,155.2
Malta	1,221.5
Bangladesh	903.8
Bahrain	968
Barbados	627.9
Taiwan	620.6
Mauritius	593.6

Britannica Book of the Year (2002) Report on World Population-According to the report, the world's population was estimated at 6,188,991,000 in the year 2002.

The ten most populous countries are China, India, U.S.A., Indonesia, Brazil, Russia, Pakistan, Japan, Nigeria and Bangladesh.

Highest Capital : The highest capital in the world, before the domination of Tibet by China, was Lhasa, at an elevation of 3,684 metres above sea level. La Paz, the administrative de facto capital of Bolivia, stands at an altitude of 3,631 metres above mean sea level.

Major Parliaments (Names)

Country	*Parliament*
Afghanistan	Shora (National Assembly)
Albania	People's Assembly
Algeria	National People's Assembly
Angola	National People's Assembly
Argentina	National Congress
Australia	Federal Parliament (House of Representative and Senate)
Austria	National Assembly

Contd...

Country	Parliament
Bahamas	General Assembly (House of Assembly and Senate)
Belize	National Revolutionary Assembly
Bhutan	Tshogdu (National Assembly)
Bolivia	National Assembly
Botswana	National Assembly
Brazil	National Congress
Britain	Parliament (House of Commons and House of Lords)
Bulgaria	Narodno Subranie (National Assembly)
Cambodia (Kampuchea)	National Assembly
Canada	Parliament (House of Commons and Senate)
Cape Verde	People's National Assembly
China	National People's Congress
China (Taiwan)	Yuan (National Assembly)
Colombia	Congress
Cuba	National Assembly of People's Power
Denmark	Folketing
Egypt	People's Assembly
France	National Assembly
Germany	Bundestag (Lower House) and Budnesrat (Upper House)
Guyana	National Assembly
Hungary	National Assembly,
Iceland	Althing
India	Parliament (Lok Sabha and Rajya Sabha)
Indonesia	People's Consultative Assembly
Iran	Majlis
Iraq	National Assembly
Ireland	Oireachtas or National Parliament (Dail Eireann, House of Representatives and Seanad Eireann, Senate)
Israel	Knesset
Japan	Diet
Jordan	National Assembly
Kenya	National Assembly
Korea (North)	Supreme People's Assembly

Contd...

Country	***Parliament***
Korea (South)	National Assembly
Kuwait	National Assembly
Laos	People's Supreme Assembly
Liberia	National Assembly
Libya	General People's Congress
Madagascar	National People's Assembly
Malaysia	Parliament (Dewan Rakyat, Dewan Negara)
Maldives	Majlis
Mongolia	Great People's Khural
Mozambique	People's Assembly
Myanmar	Pyithu Hluttaw
(Burma)	(People's Assembly)
Nepal	National Panchayat
Netherlands	Staten General
New Zealand	Parliament (House of Representatives)
Norway	Storting
Pakistan	National Assembly
Papua New Guinea	National Parliament
Poland	Sejm
Romania	Grand National Assembly
Russia	Duma
Senegal	National Assembly
Seychelles	People's Assembly
Somalia	People's Assembly
South Africa	House of Assembly
Spain	Cortes
Sudan	National Assembly
Surinam	Staten
Sweden	Riksdag
Switzerland	Federal Assembly (National and Standerat)
Syria	People's Council
Tunisia	National Assembly
Turkey	Grand National Assembly
U.S.A.	Congress (House of Representatives and Senate)
Vanuatu	Representative Assembly
Venezuela	National Congress

Contd...

Country	Parliament
Vietnam	National Assembly
Zaire	National Legislative Council
Zambia	National Assembly

Largest Countries

Rank	Country	Area (sq. km)
1.	Russia	1,70,75,000
2.	Canada	99,76,139
3.	China	95,61,000
4.	United States	93,63,123
5.	Brazil	85,11,965
6.	Australia	76,86,848
7.	India	32,87,782
8.	Argentina	27,76,889
9.	Sudan	25,05,800
10.	Algeria	23,81,741

National Currencies

Country	Currency	Country	Currency
Afghanistan	Afghani	Brunei	Brunei Dollar
Botswana	Pula	Cambodia	Real
Albania	Lek	Bulgaria	Lev
Algeria	Dinar	Burkina Faso (Upper Volta)	Franc CFA
Andorra	French Franc and Spanish Peseta	Burundi	Burundi Franc
Angola	Kwanza	Cameroon	CFA Franc
Antigua and-Barbuda	East Caribbean-Dollar	Canada	Dollar
		Cape Verde	Escudo
Argentina	Peso	Brazil	Novo Cruz
Armenia	Dram	Central African-Republic	Franc CFA
Australia	Australian Dollar		
Austria	Shilling	Chad	Franc CFA

Contd...

Country	*Currency*	*Country*	*Currency*
Azerbaijan	Manat	Chile	Peso
Bahamas	Bahamian Dollar	China	Yuan
Bahrain	Bahraini Dinar	China (Taiwan)	New Taiwan
Bangladesh	Taka		Dollar
Barbados	Barbados Dollar	Colombia	Peso
Belarus	Belarusian Ruble	Congo	Franc CFA
Belgium	Euro	Costa Rica	Colon
Belize	Belize Dollar	Croatia	Kuna
Benin	Franc CFA	Cuba	Peso
Bhutan	Ngultrum	Cyprus	Cyprus Pound
Bolivia	The Boliviano	Czech Republic	Koruna or
Bosnia and	Conv. Mark		Crown
Herzegovina		Denmark	Krone
Djibouti	Djibouti Franc	Kyrgystan	Som
Dominica	East Caribbean	Kiribati	Australian Dollar
Dollar	Korea (North)	Won	
Dominican-	Peso	Korea (South)	Won
Republic		Kuwait	Kuwaiti Dinar
Ecuador	Sucre	Laos	Kip
Egypt	Egyptian Pound	Latvia	Lat
El Salvador	Colon	Lebanon	Lebanese Pound
Equatorial-	Franc CFA	Lesotho	Loti
Guinea		Liberia	Liberian Dollar
Estonia	Kroon	Libya	Libyan Dinar
Ethiopia	Birr	Liechtenstein	Swiss Franc
Fiji	Fijian Dollar	Lithuania	Litas
Finland	Euro	Luxembourg	Euro
France	Euro	Macedonia	Dinar
Gabon	Franc CFA	Madagascar	Malagasy Franc
Gambia	Dalasi	Malawi	Kwacha
Georgia	Lari	Malaysia	Ringgit
Germany	Euro	Maldives Rufiyaa	Maldivian
Ghana	Cedi	Mali	Franc CFA
Greece	Euro	Malta	Lira
Grenada	East Caribbean	Mauritania	Ouguyia
	Dollar	Mauritius	Mauritian Rupee

Contd...

Country	*Currency*	*Country*	*Currency*
Guatemala	Quetzal	Mexico	Peso
Guinea-Bissau	CFA Franc	Micronesia	U.S. Dollar
Guinea	Franc	Moldova	The Leu
Guyana	Guyana Dollar	Monaco	French Franc
Haiti	Gourde	Mongolia	Tugrik
Honduras	Lempira	Morocco	Dirham
Hungary	Forint	Mozambique	Metical
Iceland	New Krona	Myanmar	Kyat
India	Rupee	(Burma)	
Indonesia	Rupiah	Nauru	Australian Dollar
Iran	Rial	Nepal	Nepalese Rupee
Iraq	Iraqi Dinar	Netherlands	Euro
Ireland	Euro	New Zealand	New Zealand Dollar
Israel	Shekel	Nicaragua	Cordoba
Italy	Euro	Niger	Franc CFA
Ivory Coast	Franc CFA	Nigeria	Naira
Jamaica	Jamacian Dollar	Norway	Korne
Japan	Yen	Oman	Omani Rial
Jordan	Jordanian Dinar	Pakistan	Rupee
Kazakhastan	Tenge	Panama	Balboa
Kenya	Kenyan Shilling	Paraguay	Guarani
Peru	New Sal	Syria	Syrian Pound
Philippines	Peso	Tajikistan	Ruble
Poland	Zloty	Tanzania	Tanzanian
		Shilling	
Portugal	Euro	Thailand	Baht
Qatar	Qatari Rial	Togo	Franc CFA
Romania	Leu	Tonga	Paanga
Russia	Ruble	Trinidad and	Trinidad and
Rwanda	Rwanda Franc	Tobago	Tobago Dollar
Samoa	Tala	Tunisia	Tunisian Dinar
		Turkey	Turkish Lira
San Marino	Italian Lira	Turkmenistan	Manat
St. Vincent and	East Caribbean-	Tuvalu	Australian

Contd...

Country	*Currency*	*Country*	*Currency*
Grendadines	Dollar		Dollar
Sao Tome and		Uganda	Ugandan
Principe	Dobra		Shilling
Saudi Arabia	Riyal (SAR)	United Arab-	
Senegal	Franc CFA	Emirates	Dirham
Seychelles	Seychelles Rupee	U. K.	Pound (Sterling)
Sierra Leone	Leone	U.S.A.	U.S. Dollar
Singapore	Singapore Dollar	Ukraine	Hryvna
Slovakia	Koruna	Uruguay	New Peso
Slovenia	Tolar	Uzbekistan	Som
Solomon Island	Solomon	Vanuatu	Vatu
	Islands Dollar	Vatican City-	Euro
Somalia	Somali Shilling	State	
South Africa	Rand	Venezuela	Bolivar
Spain	Euro	Vietnam	Dong
Sri Lanka	Sri Lanka Rupee	Western Samoa	Tata
Sudan	Dinar	Yemen	Yemen Dinar
Surinam	Surinam Guilder		and Rial
Swaziland	Lilangeni	Zambia	Kwacha
Sweden	Krona	Zimbabwe	Zimbabwean
Switzerland	Swiss Franc		Dollar

First Heads of States

The first American President	George Washington
The first Prime Minister of Great Britain	Robert Walpole
The first President of India	Dr. Rajendra Prasad
The first Prime Minister of India	Pt. Jawaharlal Nehru
The first President of the Chinese Republic	Sun Yat Sen
The first Chairman of the People's Republic of China	Mao-Tse-Tung
The first Governor-General of Pakistan	Mohammed Ali Jinnah
The first Woman Prime Minister	Mrs. Bhandaranaike (Sri Lanka)

National Emblems of Some Countries

Country	*Emblem*	*Country*	*Emblem*
Australia	Kangaroo	Ireland	Shamrock
Canada	White Lily	Italy	White Lily
Denmark	Beach	Japan	Chrysanthemum
France	Lily	Pakistan	Crescent
Germany	Corn Flower	Spain	Eagle
India	Lioned Capital	United Kingdom	Rose
Iran	Rose	U.S.A.	Golden Red

Changed Names

Old Name	*New Name*	*Old Name*	*New Name*
Abyssinia	Ethiopia	Burma	Myanmar
Angora	Ankara	Calicut	Kozhikode
Banaras	Varanasi	Cambodia	Kampuchea
Baroda	Vadodara	Cape Canaveral	Cape Kennedy
Batavla/Djakarta	Jakarta	Cawnpore	Kanpur
Bathurst	Banjul	Central Province	Madhya Pradesh
Basutoland	Lesotho	Ceylon	Sri Lanka
Bechuanaland	Botswana	Christina	Oslo
Bombay	Mumbai	Cochin	Kochi
British Guiana	Guyana	Congo	Zaire
British Houndures	Belize	Constatinople	Istanbul
Decca	Dhaka	Persia	Iran
Dahomey	Benin	Poona	Pune
Dutch East Indies	Indonesia	Rangoon	Yangon
Dutch Guiana	Surinam	Saigon	Ho Chi Minh City
East Timor	Loro Sae		
Egypt	United Arab-	Salisbury	Harare
	Republic	Sandwich Islands	Hawaiian
Ellice Islands	Tuvalu		Islands
Formosa	Taiwan	Santa Isable	Malabo
Gauhati	Guwahati	Siam	Thailand
Gold Coast	Ghana	Simla	Shimla
Holland	The Netherlands		South West Africa

Contd...

Old Name	*New Name*	*Old Name*	*New Name*
Namibia			
Jubbulpore	Jabalpur	Southern Rhodesia	Zimbabwe
Jullunder	Jalandhar		
Kumroop	Assam	Spanish Guinea	Equatorial-
Lansang	Laos		Guinea
Leopoldville	Kinshasa	Stalingrad	Volgograd
Madagascar	Malagasy	St. Petersburg/	
Madras(state)	Tamil Nadu	Petrograd	Leningrad
Madras(city)	Chennai	Tanganyika and	
Malaya	Malaysia	Zanzibar	Tanzania
Manchukuo	Manchuria	Tanjore	Thanjavur
Mesopotamia	Iraq	Thana	Thane
Mysore	Karnataka	Togoland	Togo
New Hebrides	Vanuvatu	Trivandrum	Thiruvanantha-
Nippon	Japan		puram
Northern Rhodesia	Zambia	United Provinces	Uttar Pradesh
Nyasaland	Malawi	Upper Volta	Bourkina Faso
Panjim	Panaji	Vizagapatnam	Visakhapatnam
Peking	Beijing	West French`Africa	Mauritania

Major Political Parties

Country	*Political Party*
U.S.A.	Democratic Party, Republican Party
Bangladesh	Awami League, Bangladesh National Party
Britain	Labour Party, Conservative Party
China	Communist Party
India	Indian National Congress, B.J.P.
Japan	Liberal Democratic Party; Japan New Party
Nepal	Nepali Congress, Communist Party
Pakistan	Pakistan People's Party (P.P.P.), Muslim League
South Africa	African National Congress, National Party
Sri Lanka	United National Party

National Flowers

Country	Flower
Canada	Maple
England	Rose
France	Lily
Germany	Cornflower
India	Lotus
Ireland	Shamrock
Japan	Chrysanthemum
Scotland	Thistle
Spain	Pomegranate

Prestigious Residences

Name of the Residence	Occupant
Buckingham Palace	(London) King/Queen of Britain
40, Downing Street	(London) Prime Minister of Britain
Elyseie Palace (Paris)	President of France
Rashtrapati Bhavan	(New Delhi) President of India
Qasr-e-Sadarat	President of Pakistan
White House	(Washington) President of U.S.A.
Vatican (Rome)	Pope

The Sobriquets

Sobriquet	Primary Name
Land of the Rising Sun	Japan
Land of the Thousand Lakes	Finland
Land of Thunderbolt	Bhutan
Land of the White Elephants	Thailand
Mysore Tiger	Tipu Sultan
Pearl of the Antilles	Cuba
Pillars of Hercules	Gibraltar
Bengal's Sorrow	River Damodor
Blue Mountains	Nilgiri Hills

Contd...

Sobriquet	*Primary Name*
City of the Golden Gate	San Francisco, U.S.A.
City of the Golden Temple	Amritsar
Sick Man of Europe	Turkey
Sorrow of China/Yellow River	River Hwang Ho
Spice Garden of India	Kerala
Venice of the East	Alappuzha
Venice of the North	Stockholm, Sweden
White City	Belgrade, Yugoslavia
World's Bread Basket	Prairies of N. America
World's Loneliest Island	Tristan da Cunha
City of Dreaming Spires	Oxford, U.K.
City of Magnificent Distances	Washington, D.C., U.S.A.
City of Seven Hills/Eternal City	Rome
Cockpit of Europe	Belgium
Dark Continent	Africa
Emerald Island	Ireland
Pink City	Jaipur
Playground of Europe	Switzerland
Quaker City	Philadelphia
Queen of the Adriatic	Venice, Italy
Queen of the Arabian Sea	Kochi
Roof of the World	Pamirs
Saint of the Gutters	Mother Teresa
Empire City/City of Skyscrapers	New York, U.S.A.
Garden of England	Kent, England
Gateway of India	Mumbai
Gift of the Nile	Egypt
Granite City	Aberdeen Scotland
Great White Way	Broadway, New York
Herring Pond	Atlantic Ocean
Holy Land	Palestine
Hermit Kingdom	Korea

Contd...

Sobriquet	*Primary Name*
Island of Cloves	Zanzibar
Island of Pearls	Bahrain
Key of the Mediterranean	Gibraltar
Lady with the Lamp	Florence Nightingale
Land of Cakes	Scotland
Land of the Kangaroo	Australia
Land of the Golden Pagoda	Myanmar (Burma)
Land of Lilies	Canada
Land of Morning Calm	Korea
Land of the Midnight Sun	Norway
Windy City	Chicago, U.S.A.
White Man's Grave	Guinea Coast
Britain of the South	New Zealand
City of Palaces	Calcutta, India
City of the Dreaming Spires	Oxford, England
Eternal City	Rome, Italy
Forbidden City	Lhasa, Tibet
Gate of Tears	Bab-el-mandab, Jerusalem
Garden of India	Bangalore
Island of Cloves	Madagascar
Land of Golden Fleece	Australia
Land of Maple	Canada
Land of Five Rivers	Punjab, India

Principal Languages

Language	*Areas where Spoken*
Chinese (Mandarin)	China
English	U.K., U.S.A., Canada, Ireland, Australia, New Zealand
Russian	Russia
Spanish	Spain, Latin America
Hindi	North India

Contd...

Language	*Areas where Spoken*
Japanese	Japan
German	Germany, Ausrtria, Switzerland
Bengali	Bangladesh, India
Portuguese	Portugal, Brazil
Arabia	Middle East, North Africa
French	France, Belgium, Canada, Switzerland
Italian	Italy
Indonesian	Indonesia
Javanese	Java (Indonesia)
Telugu	Andhra Pradesh (India)
Tamil	Sri Lanka, Tamil Nadu (India)
Marathi	Maharashtra (India)
Urdu	Pakistan, India
Punjabi	India, Pakistan
Korean	Korea (North and South)
Ukrainian	Ukraine
Vietnamese	Vietnam
Polish	Poland
Turkish	Turkey
Gujarati	Gujarat (India)
Thai	Thailand
Malayalam	Kerala (India)
Kannada	Karnataka (India)
Farsi (Persian)	Iran
Oriya	Orissa (India)
Serbo-Crotian	Yugoslavia
Romanian	Romania
Hausa	Nigeria, Niger

Some Facts About Languages

- The exact number of the world's languages has not yet been satisfactorily determined.

- The number of known living languages exceeds 3,000, the great majority of which can be ascribed to about a dozen main language families.
- More than half of the world's population, however, can be reached by as few as 13 languages.
- The oldest recorded language is Sumerian.
- The oldest living language is Mandarin.
- The simplest language is said to be Malay.
- There are nine major language families.

Major Languages

Source : Prof. Sidney Gulbert, University of Washington, Seattle:

Language	*Speakers (in million)*
Arabic	256
Bengali	215
English	514
Hindi	496
Japanese	126
Malay	176
Mandarin	1075
Portuguese	194
Spanish	425
Russian	275

International Days

International Customs Day	January 26
World Leprosy day	January 30
International Women's Day	March 8
World Disabled Day	March. 15

Contd...

World Forestry Day	March 21
International Day for the Elimination of Racial Discrimination	March 21
World Meterological Day	March 23
World Health Day	April 7
World Heritage Day	April 18
Earth Day	April 22
International Labour Day	May 1
Press Freedom Day	May 3
Mother's Day	May (2nd Sunday)
World Red Cross Day	May 8
International Day of the Family	May 15
World Telecommunication Day	May 17
Commonwealth Day	May 24
Anti-tobacco Day	May 31
International Day of Innocent Children Victims of Aggression	June 4
World Environment Day	June 5
International Day against Drug Abuse and Illicit Trafficking	June 26
World Diabetes Day	June 27
World Population Day	July 11
World Peace Day	August 6
Nagasaki Day	August 9
International Literacy Day	September 8
World Ozone Day	September 16
Alzheimer's Day	September 21
Day of the Deaf	September 26
World Tourism Day	September 27
International Day for the Elderly	October I
World Animal Day	October 2
World Habitat Day	October 3

Contd...

World Animal Welfare Day	October 4
World Postal Day	October 9
U.N. International Day for Natural Disaster Reduction	October 13
World Standards Day	October 14
World White Cane Day (guiding the blind)	October, 15
World Food Day	October 16
U.N. Day	October 24
World Thrift Day	October 30
Africa Industrialization Day	November 20
International Day of Solidarity with Palestinian People	November 29
World AIDS Day	December 1
Human Rights Day (U.N.)	December 10

Largest, Longest, Biggest, Highest and Smallest

Airliner, Largest	...	Boeing 747
Animal, Tallest	...	Giraffe
Animal, Fastest	...	The Peregerine Falcon
Archipelago, Largest	...	Indonesia
Bird, Fastest	...	Swift
Bird, Largest	...	Ostrich
Bird, Smallest	...	Humming Bird
Bridge, Longest Railway	...	Huey P. Long Bridge (U.S.A.)
Building, Tallest in Asia	...	The Connaught Centre in Hong Kong (195 metres tall; has 46 floors)
		Building, Highest in the world Sears Tower in Chicago (440-metre high. It is a 110-storey tower which is nearly 60 metres taller than the Empire State building in New York)
Canal, Longest, small ship	...	Beloye (White Sea) Baltic Canal (CIS) 226 km long

Contd...

Canal, Longest, big ship	...	Suez Canal (U.A.R.) (161 km)
Canalised System, Longest	...	Volga-Baltic Canal (2960 km)
Capital, Highest	...	Lhasa (Before domination of Tibet by China) 3684 metres above sea-level
City, Highest	...	Wenchuan (China) 5, 100 metres above sea-level. La Paz (capital of Bolivia) stands at an altitude of 3632 metres above sea-level
City, Largest in population	...	Shanghai (10,820,000) followed by: Tokyo (8,841,000) New York (7,895,000) Beijing (7,570,000) London (7,379,000) Moscow (7,050,000)
Continent, Largest	...	Asia
Continent, Smallest	...	Australia
Coral Formation, Largest	...	The Great Barrier Reef (North-east coast of Australia)
Country, Largest in Population		China followed by India
Country, Largest (in area)	...	Russia
Country (with largest electorate)	...	India
Creature, Largest	...	Blue Whale is the largest creature in the world today. It can grow up to a weight of 150 tonnes.
Dam, Highest	...	The Grande (Switzerland)
Day, Longest	...	June 21 (in Northern Hemisphere)
Day, Shortest	...	Dec 22 (in Northern Hemisphere)
Delta, Largest	...	The world's largest delta is that created by the Ganges and Brahmaputra in Bangladesh and West Bengal, India. It covers an area of 30,000 sq. miles.
Desert, Largest (in the world)	...	Sahara (Africa)
Desert, Largest (in Asia)	...	Gobi (Mongolia)

Contd...

Diamond, Largest	...	The Cullinan (over 11/2 lb.)
Dome, Largest	...	"Astrodome" in Housten, Texas (U.S.A.); outside dia: 216 metres and inside 196 metres. (The largest dome, in India is Gol Gumbaz (Bijapur) 44 metres in Dia.)
Epic, Longest	...	Mahabharata
Forest, Largest	...	Coniferous forest of Northern Russia
Gulf, Largest	...	Gulf of Mexico
Highest Motorable Road	...	Khardungla-Leh-Manali sector 5682 Mt
Highest non-military airport	...	Leh 3256 Mt
Island, Largest	...	Greenland
Islands, Largest (Group of)	...	Malaya Archipelago
Lake, Largest Artificial	...	Lake Mead (Boulder Dam)
Lake, Deepest	...	Baikal (Siberia); average depth 701 metres
Lake, Highest	...	Titicaca (Bolivia) 3854 metres above sea level
Lake, Largest Fresh Water	...	Superior (31,200 sq miles)
Lake, Largest Salt Water	...	Caspian Sea (26 metres below sea-level)
Largest Crater	...	The Lonar in Vidharba region of Maharashtra
Largest Inland Waterway	...	Kerala
Largest Cinema Theatre	...	Thangam in Madurai; capacity 2563 persons
Largest Barrage	...	Farakka 224 km
Largest Stadium	...	Salt Lake Stadium Kolkata, 1,20,000 capacity
Largest Tribe	...	Gond
Largest Exhibition Ground	...	Pragati Maidan, New Delhi 150 Acres
Largest Ocean Island	...	Middle Andaman
Largest River Basin	...	Ganga Basin

Contd...

Largest Estuary	...	At the mouth of the river Hooghly
Largest Library (India)	...	National Library Kolkata
Largest Library (World)	...	United States Library of Congress, Washington, D.C. (more than 59,000,000 items).
Lenin State Library, Moscow	...	Claims to house more than 20,000,000 books
Longest Ropeway in India	...	Connecting Joshimath in Uttaranchal 4.15 km long
Longest Train in India	...	Prayag Express running between Delhi and Allahabad 24 bogies
Longest Road Tunnel in India	...	Chiplin-Koya Nagar, Maharashtra 1 km long
Longest National Highway of India	...	NH-7, 2369 km
Longest Cave in India	...	Kremum Kwan Jaintia Hills, Meghalaya
Mountain Peak, Highest in the world	...	Everest (Nepal)
Mountain Peak, Highest in India	...	Godwin Austen (8,611 m)
Mountain Peak, Highest in Africa	...	Kilimanjaro (5,888 m)
Mountain Peak, Highest in Europe	...	Elbruz (Caucasus), 5,633 m
Mountain Range, Highest	...	Himalayas
Mountain Range, Longest	...	Andes (S. America), 8,800 km in length
Museum, Largest	...	American Museum of Natural History, New York city. It comprises 19 inter connected buildings with 23 acres of floor space.
Nuclear Reactor, Biggest	...	France
Ocean, Deepest and Biggest	...	The Pacific
Palace, Biggest	...	Vatican
Park, Largest	...	Wood Buffalo National Park in Alberta, Canada. Area : 17,560 sq miles.
Peninsula, Largest	...	Arabia
Place, Coldest	...	Verkhoyansk (Russia); Temperature 85' below zero

Contd...

Place, Dryest	...	Death Valley (California); rainfall 1.5 inch
Place, Hottest	...	Azizia (Libya, Africa 58°C (136°F)
Place, Rainiest	...	Cheerapunji (Meghalaya, India)
Planet, Biggest	...	Jupiter
Planet, Brightest	...	Venus
Planet, Farthest (from the sun)	...	Pluto
Planet, Nearest (to the sun)	...	Mercury
Planet, Smallest	...	Mercury
Planetarium, biggest	...	Tsukuba, Japan
Plateau, Highest	...	Pamir (Tibet)
Platform, Longest	...	Kharagpur platform in West Bengal (India)
Railway, Longest	...	Trans-Siberian Railway (9,600 km long)
Railway Station, Largest	...	Grand Central Terminal, New York City, covers 48 acres. On an average more than 550 trains and 180,000 people per day use it.
River, Longest	...	Nile (6,679 km)
Sea-bird, Largest	...	Albatross
Sea, Largest	...	South China Sea
Star, Brightest	...	Sirius (also called Dog Star) Statue, Tallest "Motherland"; an enormous female figure on Mamayev Hill, outside Volgagrad (Russia).
Tallest TV Tower	...	Rameshwaram, T.N. 1000 feet
Telescope, Largest Radio	...	The world's largest and most sensitive radio telescope, Y-shaped with each arm 21 km long with 27 mobile an tennae on rails is being built in New Mexico (U.S.A.) at a total cost of 74 million dollars.
Telescope, Largest Solar	...	Kilt Peak National Observatory, Arizona U.S.A.

Contd...

Telescope, Largest Reflector	...	Mount Semirodriki, in the Caucasus (CIS)
Telescope, Largest Refractor	...	Yerkes Observatory, Wisconsin (U.S.A.)
Tunnel, Longest Railway	...	Secken Tunnel (Japan)
Tunnel, Longest Road	...	St. Gothard tunnel in Switzerland (16.32 km)
Village, Highest	...	Andean (Chile) 5334 metres above sea-level
Volcano, Highest	...	Cotopaxi (Andes, Ecuador)
Volcano, Largest	...	Mauna Lea (Hawaii); crater
Wall, Longest	...	Great Wall of China (2400 km)
Waterfall, Greatest	...	Victoria Falls on river Zambesi (Zambia) in the world 1700 metres wide.
Waterfall, Highest	...	Angel Venezuela)
Water, Lowest body	...	Dead Sea

Seven Wonders of the Ancient World

(1) The Pyramids of Egypt; (2) the Hanging Gardens of Babylon; (3) the temple of Artemis at Ephesus; (4) the statue of Zeus at Olympia; (5) the mausoleum at Halicarnassus; (6) the Colossus of Rhodes; (7) The Pharos (Light house) at Alexandria.

Seven Wonders of the Medieval World

(1) The Colosseum of Rome; (2) the Great Wall of China; (3) the Procelain Tower of Nanking; (4) the Mosque at St. Sophia (Constantinople); (5) the Stone age of England; (6) the Catacombs of Alexandria; (7) the Leaning Tower of Pisa.

Towns Associated with Industries

Baku [Russia]	...	Petroleum
Bangkok [Thailand]	...	Shipping
Befast [Ireland]	...	Ship-building, Linen goods

Contd...

Buenos Aires [Argentina]	...	Dairy Products
Cadiz [Spain]	...	Cork
Chicago [U.S.A.]	...	Gramophone
Detroit [U.S.A.]	...	Automobiles
Dresden	...	Optical and Photographic Apparatus
Glassgow [Scotland]	...	Machinery, Textiles
Havana [Cuba]	...	Cigar
Hollywood [U.S.A.]	...	Films
Johannesburg [S. Africa]	...	Gold Mines
Kimberley [South Africa]	...	Diamond Mining
Leeds [England]	...	Woollen Goods
Los Angeles [U.S.A.]	...	Film, Oil
Lyons [France]	...	Silk
Morocco [North Africa]	...	Leather
Munich [Germany]	...	Lenses
New Orleans [U.S.A.]	...	Cotton
Pitsburgh [U.S.A.]	...	Iron and Steel
Plymouth [England]	...	Ship-building
Sheffield	...	Cutlery
Sun belt (USA)	...	Food Processing
Venice [Italy]	...	Glass
Vienna [Austria]	...	Glass
Wellington [New Zealand]	...	Dairy Products

Countries Associated with Industries

Afghanistan : Carpets, wool, dry and fresh fruits.

Australia : Wheat, wool, meat, dairy products.

Austria : Machinery, textile, leather goods.

Belgium : Glass, textiles.

Brazil : Coffee.

Canada : Wheat, machinery, newsprint.

Chile : Copper.

China : Rice, tea, silk, iron and steel, oil refining.

Cuba : Sugar, Tobacco.

Denmark : Dairy products.

England : Textiles, machinery, medicines, motor cars.

Finland : Textiles, paper.

France : Textiles, silk, wine.

Germany : Machinery, iron and steel goods, equipment and transport equipment, chemical products, refrigerators, television, washing machines, lenses, radio etc.

Ghana : Gold, manganese, coffee.

India : Sugar, hides and skins, mica, manganese, tea, lac, jute,

Indonesia : Sugar, spices, rice, oil, rubber, cinchona.

Iran : Petroleum, dry fruits, carpet.

Iraq : Petroleum, dates.

Italy : Textiles, mercury.

Japan : Automobiles, machinery, textiles, toys, silk, hosiery electronics.

Kuwait : Petroleum.

Malaysia : Tin, rubber.

Mexico : Silver, petroleum.

Netherlands : Machinery, electrical goods, aircraft.

Russia : Heavy machinery, petroleum, iron and steel, chemicals.

Saudi Arabia : Oil and dates.

Spain : Lead.

Sweden : Matches, timber.

Switzerland : Watches, electrical equipment.

South Africa : Gold and diamond mining.

Taiwan : Rice, Camphor.

U.S.A. : Automobiles, machinery, coal, wheat, petroleum.

Vietnam : Tin, cinchona, rubber, rice and teak.

West Indies : Sugar, tobacco.

Minerals, Crops and Other Products

Aluminium : U.S.A., Canada, Norway, Switzerland, France and India.

Carpets : Iran and India.

Cheese : U.S.A., England, Netherlands and Australia.

Coal : U.S.A., England, Germany, Russia, Australia and India.

Coca : Ghana, S. America and West Indies.

Coffee : Brazil, Columbia, Indonesia, Ethiopia.

Copper : Chile, U.S.A.

Cotton : U.S.A., Uzbekistan, Egypt, India, Brazil, Argentina and Pakistan.

Electric Bulbs : U.S.A., England, India.

Gold : S. Africa, Australia, Canada, S. America, India.

Grapes : France, Italy, Portugal, California (U.S.A.).

Ilmenite : India.

Iron Ore : U.S.A., Russia, U.K., France, Germany, India.

Jute : Bangladesh, India.

Manganese : Russia, India.

Mica : India.

Monazite : India.

Petroleum : U.S.A., Venezuela, Russia, Middle East Countries, Iran and Indonesia.

Plastic Goods : England, U.S.A., Japan.

Rice : China, India, Bangladesh, Indonesia, Japan and Burma.

Rubber : Malaysia, Indonesia, Thailand, China and India.

Silk : China, U.S.A., France, India and Japan.

Silver : Mexico, U.S.A., Peru and India.

Steel : U.S.A., Germany, Russia, England and Japan.

Tea : India, China, Sri Lanka, Japan and Indonesia.

Tin : Malaysia, Brazil, Indonesia, China and Thailand.

Wheat : China, U.S.A., India, Canada, Argentina, and Australia.

Wool : Australia, Argentina, New Zealand and S. Africa

3

Solar System

The sun is the ultimate source of energy for the processes of change on the earth's surface and in the atmosphere. Our sun is a ball of constantly churning gases that are heated by continuous nuclear reactions. It is about average in size compared to other stars, and it has a surface temperature of about 6,000°C (about 11,000°F).

Like all objects, it emits energy in the form of electromagnetic radiation. The energy travels outward in straight lines, or rays, from the sun at a speed of about 1,86,000 km (30,000 mls) per second. At that rate, it takes the energy about $8\frac{1}{3}$ minutes to travel the 150 million km (93 million miles) from the sun to the earth.

The Sun

As solar radiation travels through space, none of it is lost. However, the rays spread apart as they move away from the sun. This means that a planet farther from the sun, like Mars, receives less radiation than one located near the sun, like Mercury and Venus. The earth intercepts only about one half of one billionth of the sun's total energy output.

Warming System

The atmosphere is not directly heated by the sun from above. It is rather heated from below. The processes of heating of the atmosphere are: *convection, conduction,* and *radiation.*

Convection : The transmission of heat from one part of a liquid or gas to another by movement of the particles themselves is known as *convection.* When the lower part of a mass of liquid is heated, it expands, its density is reduced, and it rises, carrying its heat with it—to be replaced by cool fluid which in turn is heated. A familiar example of convection is the upward movement of air which has been heated by contact with the earth's surface; this air is said to rise in a convection current. In other words, convection requires a mobile medium like air or water; it is readily observed when a dish of water is heated on a stove. The hot water at the bottom of the pan rises and circulates to redistribute the heat. A bubbling pot is an example of convection at work.

Conduction : Conduction is a process in which heat is transferred directly through matter from a point of high temperature to a point of low temperature by molecular impact but without overall movement of the matter itself. Conduction transfers heat between adjacent molecules. Heat passes from warmer to colder substances as long as temperature difference exits. Thus, when the surface absorbs radiation and warms above the air temperature, conduction transfers part of the heat to the lower layer of air.

When the surface is cooler than the overlying air, the heat transfer is reversed and the air is cooled. The latter phenomenon is common over land at night and during winter in the middle and high altitudes. Air is a poor conductor of heat.

Radiation : It is a process by which a body emits radiant energy (energy received from the sun), e.g., in the form of heat. It causes a loss of heat and, therefore, leads to cooling. Although the sun is the initial and primary source of the heat, the air is heated mainly by reradiation from the underlying land or water surface. Radiant energy is constantly emitted in all directions by the sun. Some of this energy reaching the earth is being converted into heat. Earth is constantly losing heat into space by radiation. During the day, the heat received from the sun by insolation exceeds the amount lost by radiation, and the temperature rises till a maximum is reached. At night, the reverse is the case, and the temperature falls till a minimum is reached. In summer, when the days are long and the sun is high, the ground grows gradually warmer, but in winter when the days are short, and the sun is low, radiation so far exceeds insolation that the ground becomes cold. The land loses radiation more rapidly than water, and high ground more rapidly than low ground.

Energy from Sun

Solar radiation that is intercepted by the earth is known as *insolation.* The amount of insolation reaching the outer limit (480 km, 300 miles) of the atmosphere is termed as *solar constant.* The amount of insolation intercepted by earth on a surface perpendicular to the sun's rays when earth is at its average distance from the sun is 1370 watts per square metre, averaged over the entire globe at the thermopause or 1.968 calories per cm^2 per minute. Insolation is measured with the help of pyranometers. The amount of insolation reaching any place during one day depends on:

- the area and nature of the surface,
- the inclination of the rays of the sun,
- the transparency of the atmosphere, and
- the position of the earth on its orbit.

The amount of solar constant varies throughout the day with the changes in the angle of incidence of the sun's rays; and the length of time that the sun remains above the horizon is a determining factor. At the equinoxes, that time is twelve hours per day everywhere on the equator, but towards the summer solstice the longer days of the higher latitudes more than compensate for the great obliqueness of the sun's rays. Thus, the total insolation per day is not at its maximum at the latitude where the sun is highest at noon, but at a rather higher latitude where the daily duration of the sunlight is greater. For the year as a whole, however, insolation is greatest at the equator, it decreases at first slowly then more rapidly, and slowly again towards the poles. Insolation shows the least variation throughout the year at the equator, but varies very considerably at the poles.

Insolation is the single energy input driving the earth's atmosphere system. It includes all radiation arriving at earth's surface, both direct and diffuse (as downward scattered).

For example, insolation decreases poleward from 25 degrees latitude in both the northern and the southern hemispheres. Consistent daylight and high sun altitude produce average insolation of 180-200 W/m^2 throughout the equatorial and tropical latitudes. In general, insolation of 240-280 W/m^2 occurs in low-latitude deserts worldwide because of frequently cloudless skies. Note the energy pattern in cloudless subtropical deserts in both hemispheres (for example, the Sonora, Saharan, Arabian, Atacama, Namibia, Kalahari, and Australian-Gibson deserts).

Albedo : The proportion of solar radiation falling on a non-luminous body which the latter reflects, usually expressed as decimal, is known as *albedo.* In other words, it is the reflective quality of a surface, expressed as the relationship of incoming to reflected insolation and stated as percentage, a function of surface colour, angle of incidence, and surface texture.

The albedo of the earth is approximately 0.4, i.e., about 40 percent of the solar radiation is reflected back into space. The value is much higher for a snow covered surface, and lower for dark soil. Albedo varies within wide limits, depending on the substance involved. Some typical values of albedo have been given in Table.

In general, darker colours have lower albedos, and lighter colours have higher albedos. On water surface, the angle of the solar rays also affects albedo values; lower angles produce a greater reflection than do higher angles. In addition, smooth surfaces increase albedo, whereas rougher surfaces reduce it. Specific locations experience highly variable albedo during the year in response to changes in cloud and ground cover. The rate of albedo is between 19 and 38 percent between the tropics (23.5°N to 23.5°S), to as high as 80 percent in the polar regions. In general, the earth's atmosphere system directly returns back to space slightly less than one-third (29 to 34 percent) of the solar radiation it receives.

Considering normal amounts of cloud and snow cover and other factors, the albedo of the earth, as a whole, has been estimated at about 40 percent (recent observations by satellites seem to indicate somewhat lower values), but further measurements are needed to determine long-time global averages.

Radiation and Heat

Radiation is the means by which solar radiation reaches the earth and the earth loses energy to outer space. The global radiation budget has three major components:

- solar radiation incoming at the outer limits of the atmosphere (Qs),
- the planetary albedo (a), and
- outgoing long-wave radiation from the earth to space (I).

Thus, the basic form of the budget equation for the earth and its atmosphere is: R = Qs (1-a)-I. Here, R is the radiation balance (surplus or deficit) and (1-a) in the percentage of total insolation which is absorbed by the earth and atmosphere. Note that whereas insolation is intercepted on an area equivalent to the cross-section of the earth atmosphere, terrestial radiation is emitted from the entire sphere, an area four times larger. Of the total incoming (Qs) about 26 percent is reflected by clouds or scattered back to space by clouds, dust, and gas molecules without heating the air; 4 percent is reflected to space from the earth's surface.

The earth's mean albedo (known as the *planetary albedo)* is about 30 percent, although its value is greater in polar regions than at the equator, varying with the angle of incidence as well as the characteristics of the reflecting surfaces. The albedo of clouds varies widely with their thickness and composition. On the average, clouds cover about half of the globe, giving them a major influence on the radiation budget (Table).

Albedo of Various Surfaces

Surface	***Percent Reflected***
Clouds, stratus	
150 metres thick	25-63
150-300 metres thick	45-75
300-600 metres thick	59-84
Average of all types and thicknesses	50-55
Concrete	17-27
Crops, green	5-25
Forest, green	5-10
Meadows, green	5-25
Ploughed field, moist	14-17
Road, blacktop	5-10
Sand, white	30-60
Snow, fresh-fallen	80-90

Contd...

Surface	*Percent Reflected*
Snow, old	45-70
Soil, dark	5-15
Soil, light (or desert)	25-30
Water	8*

Typical value for water surface, but the reflectivity increases sharply from less then 5 percent when the sun's altitude above the horizon is greater then 30 degrees to more then 60 percent when the altitude is less then 3 degrees. Rough seas have a somewhat lower albedo than calm seas.

About 19 percent of insolation is absorbed in the atmosphere by gases, clouds and suspended solids. Oxygen and ozone at levels absorb most of the ultraviolet radiation to provide the main source of energy for circulation above 30 km. Water vapour, clouds, and dust are the principal absorbers of incoming long-wave radiation in the troposphere. The earth's surface absorbs 51 percent of insolation, either directly or after diffuse scattering downward by clouds and atmosphere. Thus, approximately 70 percent of total insolation is effective in heating the earth and its atmosphere

The earth is also a radiating body. In contrast to sun, which radiates at a temperature of 6,000°K, the earth has an average temperature of only 288°K and emits terrestrial radiation at much greater wavelengths. Although the constituents of the atmosphere collectively absorb only about one-fifty of the incoming short-wave radiation, they can capture a large part of the outgoing long-wave radiation. This ability to admit most of the insolation yet retard losses by radiation from the earth's surface is commonly known as the *greenhouse effect;* a more appropriate term is *atmosphere effect*. Besides the long-wave radiation from the earth's surface, there is also radiation from cloud layers, gases (especially water vapour and carbon dioxide) and dust to space. The total amount of energy reaching the earth over a considerable period of time is equaled to total outward losses. If this were not so the earth would soon become either very hot or very cold. Satellite observations have confirmed a fairly stable global energy budget over relatively long periods.

The radiation budget of a particular place is, however, seldom in balance. Actually, there is an annual deficit at high latitudes and a surplus at low latitudes owing to differences in the angle of incidence and surface albedos. At any latitude variations in slope, exposure, and the character of surface cover (for example, water, land or vegetation) produce regional differences in the radiation budget. In the middle and low latitudes a true radiative balance may exist briefly near the beginning and end of each daylight period, when deficits and surpluses replace one another.

Energy Transfer Process

Energy transfer processes, including radiation, maintain a balanced heat budget at the earth surface. They are represented in the equation: Rs = H + LE + A. Here, R, is the surface radiation balance (the difference between absorbed short wave radiation and the net upward long-wave radiation from the surface), H the net transfer of sensible heat between surface and atmosphere by conduction and turbulent exchange, L the latent heat of evaporation, E the rate of evaporation, and A the flux of heat between the surface and lower layers of soil or water. Energy which raises the temperature of a substance is known as *sensible heat,* that which gets transformed in the alteration of the physical state of matter (notably water) is *latent heat*.

Together the energy transfer processes effect complex exchanges between the earth's surface and the atmosphere. Local and regional energy budgets are kept in balance by transfer of addictive, sensible, and latent heat. The energy budget concept applies equally to the entire globe, geographic regions, buildings, plants, animals, and even human body. Annual heat budgets for the continents and oceans are summarised below in Table.

Annual Heat Budgets of the Continents and Oceans (kilolangleys per year)

Continent	*Net Radiation*	*Latent Heat Flux*	*Sensible Heart Flux*	*Subsurface Transport*
Africa	68	26	42	0
Antarctica	-11	0	-11	0
Asia	47	22	25	0
Australia	70	22	48	0
Europe	39	24	15	0
North America	40	23	17	0
South America	70	45	25	0
All land	49	25	24	0
Ocean				
Arctic	-4	5	-5	-4
Atlantic	82	72	8	2
Indian	85	77	7	1
Pacific	86	78	8	0

Source: Budyko and Sellers.

Surface Mean Temperatures

In order to study the climates systematically and to ascertain the influence of climatic factors on the economy and society of a macro or micro region, several kinds of temperature values are required. Probably, the most used basic temperature value is the daily mean from which monthly mean and annual average values can be derived. In practice the daily mean is found by adding the 24-hour maximum to 24-hour minimum and dividing by 2, because comparatively few stations in the world take hourly or continuous temperature observations, which would afford a better basis for statistical mean. The difference between the highest and the lowest temperatures of the day is the diurnal (daily) range. Ordinarily, observations of the maximum and the minimum thermometers are the bases of the daily mean temperature and the diurnal range. The mean monthly temperature is found by adding the daily means and dividing by the number of days in the month. Mean monthly values for the year indicate the annual march of temperature through the seasons. The annual range is the difference between the mean temperatures of the warmest and the coldest months. For most stations in the Northern Hemisphere, the warmest month is July and the coldest month is January. When corresponding temperature values for a number of years are averaged, a generalised value useful in climatic description is obtained. However, such averages tend to obscure the year-to-year variability of temperature and possible climatic fluctuations.

In the middle and high latitudes, the length of the frost-free season is commonly a part of the temperature record. The frost-free season is defined as the number of days during which temperatures are continuously above 0°C. The mean frost-free season is the difference in days between the mean date of the last frost in spring and the mean date of the first frost in autumn. It is often regarded as an important consideration in agriculture, but there is actually no simple, direct relation between plant growth and freedom from frost.

Mean Surface Temperatures (0°C) at Selected Latitudes

Latitude	*January*	*July*
35°	10	36
40°	5	24
45°	-2	21

Contd...

Latitude	*January*	*July*
50°	-7	18
55°	-11	16
60°	-16	14
65°	-23	12
70°	-26	7
75°	-29	3
80°	-32	2
85°	-38	0
90°	-41	-1

Source: Meinardus.

It may be observed from the Table that the mean surface temperature declines steadily from 35°N towards the pole. The decrease in temperature is, however, remarkably high in the winter season (January) to that of the summer season (May).

The Inconsistancy

The amount of insolation received on any date at a place on earth is influenced by:

1. Solar radiation reaching the outer limits (480 km, 300 miles) of the atmosphere, which depends on:
   (a) energy output of the sun,
   (b) distance from the earth to the sun, and
   (c) interstellar dust in the solar system.
2. Transparency of the atmosphere.
3. Duration of the daily sunlight period.
4. Angle at which the sun's noon rays strike the earth.

The solar radiation reaching the outer limits depends on the energy output of the sun which to a large extent is influenced by the number and frequency of sun spots (a whirling mass of gas just within the sun's atmosphere). Higher the number of sun spots, more is the heat emitted from the sun. The ellipticity of the earth's orbit around the sun also influences the insolation received on the earth. At the stage of *aphelion* (July 4) the earth is about 152 million km from the sun and at *perihelion* (January 3) about 147 million km from the sun. Consequently, the amount of solar radiation reaching the outer atmosphere varies by ±3.5 percent from the mean. Other factors influencing the heat budget and temperature, however, largely override this difference. Similarly, the effect of extraterrestrial dust is believed to be negligible.

Transparency of Atmosphere

Transparency of the atmosphere has a more important bearing on the amount of insolation which reaches the earth's surface. The effect of dust, clouds, carbon dioxide, water vapour, etc., on the incoming solar radiation and earth temperatures is immense.

Transparency is also a function of latitude, for at middle and high latitudes the solar beam must penetrate the reflecting-absorbing atmosphere at a lower angle than in tropical latitudes. This effect varies with the seasons, being greater in winter when noon sun is lowest on the horizon.

The duration of daylight (the photo period) also varies with latitude and the seasons. Longer the photo period, the greater is the total possible insolation (Table). At the equator, day and night are always almost equal. In the polar regions the daily photo period reaches a maximum of 24 hours in summer and a minimum of zero hours in winter. At its summer solstice, under clear skies, a polar area may receive more radiation per 24-hour day than lower latitudes, although the net radiation used for heating is reduced because of the high albedo of ice and snow surfaces.

Longest Possible Duration of Insolation

Latitude	0°	17°	41°	49°	63°	66½°	90°
Daylight	12hr	13hr	15hr	16hr	20hr	24hr	6 months

Source: Critchfield.

The effect of the varying angle of the solar beam can be seen in the daily march of the sun across the sky. At or near solar noon the intensity of insolation at the earth surface is greatest, but in the morning hours, when the sun is at a low angle, intensity is reduced. The same principle applies to latitude and seasons. In winter and at high latitudes the sun's noon angle is low; in summer and at low latitudes it is more nearly vertical. The oblique rays of the low-angle sun are spread over a greater surface than perpendicular rays, therefore they produce less heating per unit area.

The angle at which solar radiation strikes the earth's surface also depends on terrain features. In the Northern Hemisphere, southern slopes receive a more direct solar beam, where as northern slopes may be entirely in the shade. The possible hours of direct sunshine during winter in a deep valley may be reduced to zero by surrounding hills.

It is clear from the above discussion that the world distribution of possible insolation at the surface is closely influenced by latitude. At the equator, the annual amount is about four times that at either of the poles. As the direct solar rays shift seasonally from one hemisphere to the other, the zone of maximum possible daily insolation moves with it. In tropical latitudes the amount of possible insolation is constantly great, and there is little variation with the seasons. But, in the annual journey, the sun passes over all places between the Tropic of Cancer and the Tropic of Capricorn twice, causing two maximums. In latitudes between 23½ and 66½ degrees, the maximum and the minimum periods of insolation occur shortly after the summer and winter solstices, respectively. Beyond the Arctic and Antarctic Circles the maximum insolation coincides with the summer solstice, but there is a period during which insolation is lacking. The length of the period increases toward the poles, where it is of six months duration.

It is interesting to note that the maximum annual values of temperature are at about 20 degrees latitude, where the drier air permits a greater proportion of the radiant energy to penetrate to surface levels. Cloudy regions receive less insolation at the surface than do areas with predominantly clear weather. In general, high plateaus and mountains are favoured by more effective insolation because of the relatively clearer and less dense air at high altitude. It is because of this factor that Leh and Kargil (Laddakh) and Lhasa (Tibet) receive more effective insolation.

Horizontal Distribution : The average global surface temperature is about 13°C but local averages vary widely. On maps, the horizontal distribution of temperature is generally shown by isotherms (lines joining the points of equal temperature). On weather maps of small areas the actual observed temperatures are used as a basis for drawing isotherms, but on continental or world maps mean temperatures are frequently reduced to sea level equivalents by adding 6°C for each 1,000 metres of elevation. This adjustment essentially eliminates the effect of altitude on temperature and thus facilitates the mapping of horizontal temperature differences.

The horizontal distribution of temperature is largely determined by latitude. The general decrease in temperatures from the equator towards the poles is one of the most fundamental and best known facts of climatology (Table). If the effect of latitude were the only controlling factor affecting net radiation, we would expect a world temperature map to have isotherms lying parallel to each other in the same fashion as parallels of latitudes. But such is not the actual case.

Factors at Work

Thus, the horizontal distribution of temperature is the function of numerous other physical factors. The factors which influence the horizontal distribution of temperature on the surface of the earth are: (i) latitude, (ii) altitude, (iii) cloud cover, (iv) coastal and continental locations, (v) ocean currents, and (vi) nature of the surface.

Latitude : The latitudinal location of a place has a close influence on insolation which determines the temperature. In general, the lower the latitude of a place, the more the solar energy it receives annually. The sun's rays are vertical on equator and slanting on higher latitudes.

Moreover, when solar rays approach the earth at a more nearly vertical angle in lower latitudes, they must pass through a smaller thickness of absorbing and reflecting atmosphere before reaching the surface. Thus, the intensity of insolation decreases as one moves away from the sub-polar point, a point that migrates between the Tropic of Cancer and Tropic of Capricorn—that is, between 23.5°N and 23.5°S—during the year. In addition, daylight and sun angle change throughout the year, increasing the seasonal effect with increasing latitude. Consequently, from equator to poles, earth ranges from continually warm, to seasonally variable, to continually cold.

The effect of latitude on seasonal variation is also significant. For example, more solar energy is received at the poles at summer solstice than at the equator. Thus, the latitude and time of year have a close bearing on the horizontal distribution of temperature.

Altitude : In general, in the troposphere, temperatures decrease with increasing altitude above earth's surface. The normal lapse rate of temperature change with altitude in 6.4°C/ 1000 metres or 3.5°F/ 1000 feet. Thus, throughout the world, mountainous areas experience lower temperatures than do regions near sea level even at similar latitudes. The density of atmosphere also diminishes with increasing altitude. The density of atmosphere at an elevation of 5,500 metres (18,000 feet) is about half of that at sea level. As the atmosphere thins, its ability to absorb and radiate heat is reduced.

The consequences are that average air temperatures at higher elevations are lower, night-time cooling increases, and the temperature range between day and night and between areas of sunlight and shadow is also greater. Temperatures may decrease noticeably in the shadows and shortly after sunset. Surfaces both gain heat rapidly and lose heat rapidly to the thinner atmosphere. Also, at higher elevations the insolation received is more intense because of the reduced mass of atmospheric gases. As a result of this intensity, the ultraviolet energy component causes sunburn and pneumonia (a distinct hazard). It is because of this factor that tourists at high altitudes like Kargil, Leh (Laddakh) and Lhasa (Tibet) are always advised to get acclimatised for a few days before going for any outdoor adventure.

The existence and oscillation of the snowline in the mountains is mainly because the temperature decreases as the altitude increases. In fact, the snowline's location is a function both of elevation and latitudes if the elevation is great enough. In equatorial mountains, the snowline occurs approximately 5,000 metres (16,400 feet) and permanent ice fields and glaciers exist on equatorial mountain summits in the Andes and east Africa. With increasing latitude towards the poles, snowline gradually descents in elevation from 2,700 metres (8,850 feet) in mid-latitudes to lower than 900 metres (2,950 feet) in southern Greenland.

Two cities in Bolivia illustrate the interaction of the two temperature controls—latitude and altitude shows temperature data for the cities of Concepcion and La Paz, which are almost near the same latitude (about 16°S). Note the elevation, average annual temperature and precipitation for each city (Table). The hot humid climate of Concepcion at its much lower elevation (490 metres) stands in marked contrast to the cool, dry climate of highland La Paz. People living around La Paz actually grow wheat, barley, and potato—crops characteristically grown in cooler mid-latitudes—despite the fact that La Paz is 4,103 metres (13,461 feet) above the sea level. The combination of elevation and equatorial location guarantee La Paz nearly constant daylight and moderate temperatures, averaging about 9°C (48°F) for every month. Such moderate temperature and moisture conditions lead to the formation of more fertile soils than those found in the warmer and wetter climate of Concepcion.

Station

	Concepcion (Bolivia)	*La Paz (Bolivia)*
Latitude/longitude	16°15'S, 62°03'W	16°30'S, 68°10'W
Elevation	490 metres (1607.6 feet)	4103 metres (13,461 feet)
Average annual temperature	24°C (75.2°F)	9°C (48.2°F)
Annual range of temperature	5°C (9°F)	3°C (5.4°F)
Annual precipitation	121.2 cm (47.7 in)	55.5 cm (21.9 in)
Population	768,000	993,000

Source: Christopherson.

Cloud Cover : The distributional pattern of temperature is also significantly influenced by the type, height, and density of cloud cover. Orbital surveys reveal that approximately 50 percent of the earth is cloud covered at any one time. Clouds are the most variable factor influencing earth's radiation budget, and they are the subject of much investigation and effort to improve computer models of atmospheric behaviour and weather forecasting.

Clouds have moderating influence on temperature, producing lower daily maximums and high night time minimums. Acting as insulation, clouds hold heat energy below them at night, preventing more rapid radiation losses, whereas during the day, clouds reflect insolation as a result of their high albedo values. The moisture in clouds both absorbs and liberates large amounts of heat energy, yet another factor in moderating temperatures at the surface. The earth atmosphere energy system responds with slightly low temperatures as a result of cloud cover.

Coastal and Continental Locations : The location of a place in relation to sea/ocean and interior of a continent also controls the distributional pattern of temperature. The physical nature of the substances themselves—rock and soil vs. water—is the reason for the land-water heating differences. More moderate temperature patterns are associated with water bodies, compared to more extreme temperatures inland. The coastal towns and cities have more uniform temperatures throughout the year as they receive marine air from the prevailing winds. These places remain cooler in summer and warmer in winter. Contrary to this, the town and cities located in the interior parts of the continents show much larger annual variations in temperature. In general, the continents tend to become warmer in summer than oceans in the same latitudes but appreciably colder in winter; the larger the landmass, the greater the contrast. Thus, extreme temperatures with a large seasonal range are the results of continentality, which affects the Northern Hemisphere more than the Southern Hemisphere.

Evaporation : More of the energy arriving at the ocean's surface is expended for evaporation than is expected over a comparable area of land. An estimated 84 percent of all evaporation on the earth is from the oceans. When water evaporates and thus changes to water vapour, heat energy is absorbed in the process and is stored in the water vapour. This stored heat energy is called latent heat. One can experience this evaporation heat loss (cooling) by wetting the back of your hand and then blowing on the moist skin. Sensible heat energy is drawn from your skin to supply some of the energy for the water's evaporation, and you feel the cooling. Similarly, as surface water evaporates, substantial energy is absorbed, resulting in a lowering of nearby air temperatures. The land containing far less water, experiences far less evaporation, and therefore is moderated less by evaporative cooling.

Transparency : The transmission of light differs between soil and water; solid ground is opaque and water is transparent. Consequently, light striking a soil surface does not penetrate and gets accumulated during times of exposure and is rapidly lost at night or in shadow. The maximum and the minimum temperatures are generally experienced right at ground level. Below the surface, even at shallow depths, temperatures remain about the same throughout the day. This situation often exists at a beach, where surface sand may be painfully hot to feet but the sand a few centimetres below the surface feels cooler and offers relief.

In contrast, when light reaches a body of water, it penetrates the surface because of water's transparency, transmitting light to an average depth of 60 metres (200 feet) in the ocean. This illuminated zone is known as the *photic layer* and has been recorded in some ocean waters to a depth of 300 metres (1,000 feet). This characteristic of water results in the distribution of available heat energy over a much greater depth and volume, forming a larger heat reservoir than that made up of the surface layers of the land.

Specific Heat : When equal volumes of water and land are compared, water requires far more heat to raise its temperature than does land. In other words, water can hold more heat than can soil or rock, and therefore, water is said to have a higher specific heat. A given volume of water represents a more substantial heat reservoir than an equal volume of land, so that changing the temperature of the oceanic heat reservoir is a slower process than changing the temperature of land.

Movement : Land is rigid, solid material, whereas water is a fluid and is capable of movement. Differing temperature and currents result in a mixing of cooler and warmer waters, and that mixing spreads the available heat over an even greater volume than if the water were still. Surface water and deeper water mix, redistributing heat energy. Both ocean and land surfaces radiate heat at night, but land loses its heat energy more rapidly than does the moving mass of the oceanic heat reservoir.

Ocean Currents : Ocean currents are either warm or cold water in nature. They keep coastal water somewhat warmer or cooler than expected. As a specific example, the Gulf Stream moves northward off the east coast of North America, carrying warm water far into the North Atlantic Ocean.

As a result, the southern coast of Iceland experiences much milder temperatures than would be expected for a latitude of 65°N, just below the Arctic Circle (66.5°N). In Reykjavik, on the south-western coast of Iceland, monthly temperatures average above freezing during all months of the year. The Gulf Stream affects Scandinavia and north-western Europe in the same manner.

In the western Pacific Ocean, the Kuroshio current, similar to Gulf Stream functions much the same in its warming effect on Japan and the Aleutian Islands. In contrast, along mid-latitude west coasts, cool ocean currents moderate air temperatures. The Canary current (west coast of Africa), Benguela current (the western coast of Namibia), California current (west of California), and the Peru current (west of Chile and Peru) are some of the important cold water currents which make the ocean's water cool even in the subtropical regions.

Nature of Surface

The earth surface is covered by land and water. The land surface has different types of rocks. Similarly, the proportion of salinity varies in the oceans. Land surfaces, in general, heat up more rapidly and intensely than the water surfaces. On the other hand, land cools more rapidly when the source of heating is cut off.

Moreover, solid earth is a bad conductor of heat, hence a shallow layer is more intensely heated. The earth is opaque, while water allows the rays to penetrate to a greater depth and so affect more water to a lesser extent. The daily fluctuations in temperature may be detected 15-18 metres (50-60 feet) below the surface of water, but not more than a metre below the surface of the ground. A water surface allows evaporation, and transference through mixing by convection currents readily set up in water. A piece of coloured paper left on the surface of a snow field will in a few hours have sunk to a depth of several centimetres because it has absorbed heat and so melted the snow around. A snow field reflects a large proportion of the rays, so that the snow remains while skiers become bronzed and get sun burns in the brilliant sunshine.

The sandy soils have a low specific heat and warm up rapidly at the surface. Swamps and waterlogged soils act like a water surface, and forests modify heating by casting shade.

Pattern of Distribution

Temperatures Decrease from the Equator to the Poles : In general, the annual insolation decreases from the equator to the poles, thus causing temperatures to decrease. In the month of January, the average temperature in the equatorial region is 25°C while on the North and South Poles the average temperatures read -35°C and -30°C respectively.

Extreme Low Temperatures are found in the Arctic and Sub-Arctic Regions : Eurasia and North America are the largest landmasses in the world. The lowest temperatures in the month of January are recorded in these areas. For example, in the month of January Verkhoyansk (Yana basin, Siberia) records mean monthly temperature of -50°C (-58°F). The cold centre over northern Canada is also quite cold (-35°C, -31°F). Greenland also records -40°C temperature in January. An important factor in keeping winter temperatures low in these regions is the high albedo of snow cover, which reflects much of the winter insolation back to space.

The Annual Range of Temperature is Low in the Equatorial Region : The sun's rays are generally vertical over the equatorial region. The January and July temperatures range between 25°C and 30°C respectively. The low range and uniformity of temperatures in the equatorial region are primarily because insolation at the equator does not change greatly with the seasons.

Isotherms make a Large North-south Shift from January to July in the Mid-latitudes in Northern Hemisphere : As we observed from the previous study that the isotherms in the months of January and July have a north-south shift respectively. In the winter, isotherms dip equator ward, while in the summer they arch poleward. For example, at Verkhoyansk (Siberia), the mean January temperature reads -50°C, while in July it records about 15°C as the mean monthly temperature. The striking difference is due to the contrast between oceanic and continental surface properties, which cause continents to heat and cool more rapidly than oceans.

Highlands are Always Colder than Surrounding Lowlands : The Himalayan mountain ranges are much colder in both January and July than the Gangetic plain. In January and July, the Himalayan region records about 0°C and 20°C temperatures respectively, while the corresponding temperatures in the Gangetic plain (Allahabad) read about 20°C and 35°C respectively. The principle at work here is that temperatures decrease with an increase in altitude.

Records of Extreme Temperatures

Record	*°C*	*Location*	*Date*
Highest official air temperature	58	Azizia, Libya	Sept. 13, 1922
Highest U.S. temperature	57	Greenland Ranch (Death Valley), California	July 10, 1913
Highest mean annual temperature	31	Lugn, Somalia	13-year mean
Lowest official temperature in Northern Hemisphere	-68	Verkhoyansk, Siberia	Feb. 5 and 7, 1892
Lowest official temperature in Western Hemisphere	-66	On Greenland ice cap at 2990 m	Dec. 6, 1949
Lowest temperature on North American continent	-63	Snag, Yukon	Feb. 3,1947
Lowest U.S. temperature	-62.1	Prospect Creek Camp, Alaska	Jan. 23, 1971
Lowest record by U.S. observers	-80.6	Amundsen-Scott Station (90°S)	July 22,1965
Lowest world surface air temperature	-88.3	Vostok Soviet Station (78°27′S 106°52′E at 3420 m)	Aug. 24, 1960

Source: Critchfield.

Areas of Perpetual Ice and Snow are Always Intensely Cold : The largest ice sheets of the world are found in Antarctica and Greenland. The perpetual snow reflects back over 80 percent of the insolation to space in the form of albedo. Moreover, the surfaces of Greenland and Antarctica are over 3,000 metres (about 10,000 feet) in their centres. Since little solar energy is absorbed, little is available to warm the snow surface and the air above it. The Arctic Ocean, bearing a cover of floating ice, also maintains its cold temperatures throughout the year. However, the cold is much intense in January than on the Greenland ice sheet, since ocean water underneath the ice acts as a heat reservoir.

Temperature's Annual Range

The difference between the hottest and the coldest month is known as the annual range of temperature. The annual range of temperature varies from region to region and from place to place.

Important Characteristics

The salient features of the annual range of temperature are as follows:

1. The annual range of temperature increases with latitude, especially over Northern Hemisphere. This trend is most clearly shown for Eurasia and North America. This is due to the contrast between summer and winter insolation, which increases with latitude.
2. The greatest annual range of temperature occurs in the sub-Arctic and Arctic zones of Asia and North America. There are two very strong centres of large annual range—one in the north-east of Siberia and the other in the north-west Canada-eastern Alaska. In these regions, summer insolation is nearly the same as that at the equator, while winter insolation is very low.

3. The annual range is moderately large on land areas in the tropical zone, near the tropics of Cancer and Capricorn. These are the regions of large deserts, e.g., Sahara (North Africa), Rub-al-khali (Saudi Arabia), Thar desert of India and Pakistan, Kalahari (South Africa), and Gibson (Australia). Dry air and the absence of clouds and moisture allow these continental locations to cool strongly in winter and warm strongly in summer, even though insolation contrasts with the season are not as great as at higher latitudes.
4. The annual range over oceans is less than that over land at the same latitude. It can be seen that at 40°N latitude, starting from the right, the range of temperature is between 5°C and 10°C (9°F and 18°F) over the Atlantic Ocean, but increases to about 30°C (54°F) in the interior North America. In the Pacific, the range falls to 5°C (9°F) just off California coast and increases to 15°C (27°F) near Japan.

   In Central Asia, the annual range of temperature is near 35°C (63°F). Again, these major differences are due to the contrast between land and water surfaces. Since water heats and cools much more slowly than land, a narrow annual range in temperature is experienced.
5. The annual range of temperature is very small over oceans in the tropical zone. It may be seen that the annual range of temperature is less than 3°C (5°F) over the equatorial water. It is mainly because the water heats and cools slowly.

Diurnal (Daily) Range : The amount of variation between the maximum and minimum of any element, such as air temperature (and relative humidity), during 24 hours is known as diurnal range. The diurnal range of temperature is usually greatest in desert regions which record high daytime temperatures followed by a rapid heat loss through *radiation* at night, owing to the clear skies.

Frost-Free Season : From the agricultural and economic point of view, the frost-free season has great significance. The *frost-free season* is defined as the number of days during which temperatures are continuously above 0°C. The mean frost-free season is the difference in days between the mean date of the last frost in spring and the mean date of the first frost in autumn.

Inversion of Temperature : Normally air temperature decreases with increasing elevation but under certain weather conditions the converse may be true. Thus, contrary to the normal environmental lapse rate, over a limited height range, air temperature increases with height so that a layer of warmer air overlies a colder layer. A surface inversion is commonly experienced in valleys and hallows. The inversion of temperature takes place:

1. In winter on calm, clear nights.
2. When radiation has caused considerable cooling and the cold air has sunk down into them.
3. When the sky is clear and anticyclone condition prevails.
4. When the earth surface is covered with ice, snow and frost.

There are two types of inversion of temperature:

A High-Altitude Inversion : The high-altitude inversion occurs mainly due to the frontal convergence, when a warm air mass is forced from the ground surface by the underlying cold air mass at a cold front. Alternatively, a similar inversion can be created when a warm air mass overrides a colder one along a warm front. Upper-air inversion also develops in the sub-tropics associated with the deep subsidence and adiabatic warming in a warm anticyclone.

A Surface Inversion : A surface inversion is much more localised and is often dependent on the terrain. It frequently occurs during winter anti-cyclonic weather when, during calm, cloudless nights, there is a rapid heat loss from the ground by radiation. Some mountain settlements have been sited to avoid these cold 'spots'.

The inversion of temperature adversely affects orchards, fruit trees and vegetables. In countries like France, Italy, Spain, and U.S.A. oil-burning heaters are used to warm the surface layer and create air circulation or large fans are used to mix the cool air at the surface with the warmer air above, in the orchards and vegetable fields.

Low-level temperature inversions often occur over snow-covered surface in winter. Inversions of this type are very intense and can extend thousands of metres into the air. They build up over many long nights in the Arctic and polar regions, where the solar heat of the short winter day cannot completely compensate for night time cooling.

Vertical Distribution : The permanent snow caps on high mountains, even in the tropics, indicate the decrease of temperature with altitude. The average rate of temperature decrease upward in the troposphere is about 6.4°C per km extending to the tropopause. This vertical gradient of temperature is commonly known as the *standard atmosphere lapse rate* or *normal lapse rate,* but it varies with height, season, latitude and other factors.

The *normal lapse rate* represents the average of many observations of vertical temperature distribution and should not be confused with the *actual lapse rate,* which indicates temperature values above a given location at a given time. Indeed, the actual lapse rate of temperature does not always show a decrease with altitude. Where observations indicate no change with altitude, the lapse rate is termed as *isothermal.*

Such a condition never occurs over a very great vertical range nor for a long period of time in the troposphere.

Global Warming

In the opinion of some of the climatologists the temperature of the earth is increasing, mainly because of the human activities. Other scientists, however, opine that the warming of the last few decades could be part of natural climatic cycle.

Carbon dioxide, produced by human activities, is a major cause of concern in climate warming. This gas is released to the atmosphere in large quantities by fossil fuel burning. The greenhouse effect is caused by atmospheric absorption of long-wave radiation, largely by carbon dioxide and water vapour, that is emitted from the earth. Also of concern are other gases that are commonly in very small concentration—methane (CH_4), nitrous oxide (NO), ozone (O_3), and chloro fluoro carbons (CFC). These gases also absorb long-wave radiation and enhance the greenhouse effect, even though they are even less abundant than CO_2. Taken together with CO_2, they are referred to as greenhouse gases.

Prior to the 1779 Industrial Revolution, carbon dioxide concentration in the atmosphere was at a level slightly less than 300 parts per million (ppm), or about 3/100ths (0.003%) of a percent by volume. During the last one hundred years or so, that amount has been substantially increased by fossil fuel burning. When fuels like fuelwood, coal, oil, or natural gas are burned, they yield water vapour and carbon dioxide. The release of water vapour does not present a problem, because a large amount of water vapour is normally present in the global atmosphere. But, because the normal amount of CO_2 is so small, fossil fuel burning has raised the level to about 350 ppm. This is a 22 percent increase.

The rapid increase in CO_2 occurred after the Industrial Revolution. Though, the CO_2 has increased with the passage of time since 1860, after 1940 or so the level, however, remained nearly stable. But, after 1940, CO_2 began a rapid rise—so rapid that at the present rate of increase (about 4 percent per year), the amount of CO_2 in the air will double by 2030. Even if worldwide fossil fuel combustion is cut to half, the prediction is that doubling will occur by 2050, only about half a century away.

Humans have tilted this balance by clearing land and burning the vegetation cover as new areas of forest are opened for development. This practice increases the amount of CO_2 in the air when agricultural land is allowed to return to its natural forest state. CO_2 is removed from the air by growing trees. At present, scientists calculate that forests are growing more rapidly than they are being destroyed in the mid-latitude regions of the Northern Hemisphere. This plant growth helps to counteract the build-up of CO_2 produced by fossil fuel burning. It may be outweighed by the tropical deforestation that is taking place in South America, Africa and South-East Asia.

Laboratory experiments have shown that plants exposed to increased concentration of CO_2 will grow faster and better. The faster they grow, the more CO_2 they can take in, which helps to reduce the amount in the atmosphere. However, scientists are unsure whether increased CO_2 will stimulate plant growth under natural conditions.

Another part of the cycle involves the oceans. The oceans' surface layer contains microscopic plant life that takes in carbon dioxide. The CO_2 in the ocean water initially comes from these microscopic floating plants. They die and their bodies sink to the ocean bottom. There they decompose and release CO_2, enriching waters near the ocean floor.

This CO_2 eventually returns to the surface through a system of global ocean current flows involving both bottom and surface currents. In this system, cold CO_2-rich bottom waters rise to the surface in the northern-most Pacific, where CO_2 is released.

Meanwhile, warmer, CO_2-poor waters sink in the northernmost Atlantic. In fact, the ocean acts like a slow conveyor belt, moving CO_2 from the surface to ocean depths and releasing it again in a cycle lasting about 1,500 years. At present, scientists estimate that ocean surface waters absorb more CO_2 than they release, owing to increased atmospheric levels of CO_2. Therefore, carbon dioxide may be accumulating in ocean depths. However, current studies of global climate computer simulation indicate that the oceans may not be as effective in removing excess CO_2 as scientists previously thought.

Although there is a great deal of uncertainty about the movements and build-up rate of excess CO_2 released to the atmosphere by fossil fuel burning, one thing is certain: Without conversion to alternative energy sources, fuel consumption will continue to release carbon dioxide, and it is only a matter of time before the earth will feel its impact.

Differences in Temperature

The temperature and environment of the large urban places differ from that of the rural settlements and countryside. In fact, it is well established that urban micro climates generally differ from those of nearby non-urban areas. The surface energy characteristics of urban areas possess unique properties similar to desert locations. Because more than 65 percent of the world's population will be living in cities by the year 2010, the study of 'urban heat islands' and other specific environmental effects related to cities is an important topic for physical geographers. The following factors contribute to urban micro climates:

Urban Surfaces Typically are Metal, Glass, Asphalt, Concrete, or Stone : These city surfaces conduct upto three times more heat than wet sandy soil. The heat storage capacity of these materials also exceeds that of most natural surfaces making cities *heat islands.* During the day and evening, higher temperatures exist above these surfaces. At night such surfaces rapidly radiate this stored heat to the atmosphere, producing minimum temperatures some 5°-8°C (9°-14°F) warmer in urban areas as compared to rural areas, especially on calm, clear nights. As a result, both the maximum and the minimum temperatures are higher than in non-urban areas, although the effect of heat island characteristic is more profound during night time cooling.

Urban Surfaces behave Differently from Natural Surfaces in Energy Balance : Albedo values are lower, leading to a higher net radiation value. However, urban surfaces expend more of that energy as sensible heat than non-urban areas; more than 70 percent of the net radiation in an urban setting is spent in this way.

The Irregular Geometric Shapes of a Modern City Affect Radiation Pattern and Winds : Incoming insolation is caught in maze-like reflection and radiation 'canyons' which tend to trap energy for conduction into surface materials, thus easing temperatures. In natural settings, insolation is more readily reflected, stored in plants, or converted into latent heat through evaporation.

Buildings tend to interrupt wind flows, thereby diminishing heat loss through adjective (horizontal) movement. Winds average 25 percent velocity in cities than in rural areas, although buildings create local turbulence and funneling effects. Wind flows can significantly reduce heat island effect by increasing turbulent heat loss. Thus, maximum heat island effect in most build-up areas of a city occur on calm, clear days and nights.

Human Activity Alters the Heat Characteristics of Cities : In Delhi, Kolkata, Mumbai, Chennai, Karachi, Dhaka, New York, Tokyo, Mexico City, Sao Paulo, Rio-de-Janeiro, Lagos, Cairo, London, etc., for example, during the summer months, production of electricity and use of fossil fuels release an amount of energy equivalent to 25-50 percent of the arriving insolation.

In the winter, urban generated heat is on the average 250 percent greater than arriving insolation.

Urban Surfaces are Generally Sealed (built on and paved) so that Water cannot Reach the Soil : Central business districts are on the average 50 percent sealed, whereas suburbs are 20 percent sealed. Because urban precipitation cannot penetrate the soil, water run-off increases. Urban areas respond much as a desert landscape: a storm may cause a flash flood over the hard, sparsely vegetated surfaces, only to be followed by a return to dry conditions a few hours later. Little of the net radiation is expended for evaporation on such a surface.

The Amount of Air Pollution, including Gases and Aerosols, is Greater in Urban Areas than in Comparable Natural Settings : Pollution actually increases reflecting (albedo) in the atmosphere above the city, thus reducing insolation reaching the ground. The pollution blanket also absorbs infrared radiation, radiating the heat downward. Every major city produces its own dust dome of air-borne pollution, which can be blown from the city in elongated plumes, depending on wind direction. The increased particulates present in pollution act as condensation nuclei for water vapour. Convection created by the heat island lifts the air and particulates, producing increased cloud formation and the potential for increased precipitation. Although these precipitation effects of the urban heat island are difficult to isolate and prove, research suggests that urban stimulated precipitation occurs downwind from cities.

Average Differences in Climatic Elements between Urban and Rural Environments

Element	*Urban Compared to Rural Environs*
Contaminants	
Condensation nuclei	10 times more
Particulates	10 times more
Radiation	

Contd...

Element	***Urban Compared to Rural Environs***
Total on horizontal surface	0-20% less
Sunshine duration	5-15% less
Precipitation	
Amounts	5-15% more
Snowfall, downwind (lee) of city	10% more
Thunderstorms	10-15% more
Temperature	
Annual mean	0.5-3-0°C (0.9-5.4°F) warmer
Summer maxima	1.0-3°C (l.8-3.0°F) warmer

Source: Landsberg.

Conclusion : To summarise, the two major cycles of air temperature—daily and annual—are controlled by the cycles of insolation produced by the rotation and revolution of the earth. These cycles induce cycles of net radiation at the surface. When net radiation in the daily cycle is positive, air temperatures increase, and when negative, air temperatures decrease. This principle applies for both daily and annual temperature cycles. Days are warm and nights are cool as net radiation goes from positive to negative. Summers are warm and winters are cold because average net radiation is high in the summer and low in the winter. Surface characteristics affect temperatures, too. Rural surfaces are generally moist and slow to heat, while urban surfaces are dry and absorb heat readily. This difference creates an urban heat island effect.

Air temperatures normally fall with altitude in the troposphere. At the tropopause, this decrease stops. In the stratosphere above, temperatures increase slightly with altitude. Air temperatures observed at mountain locations are lower with higher elevation, and day-night temperature differences increase with elevation.

Daily and annual temperature cycles are influenced by maritime or continental location. Ocean temperatures vary less than land temperatures because water heats more slowly and can both mix and evaporate freely. Maritime locations that receive oceanic air, therefore, show smaller ranges of daily and annual temperature.

Global temperature patterns for January and July show the effects of latitude and maritime-continental location. Equatorial temperatures vary little from season to season. Poleward temperatures decrease with latitude, and continental surfaces at high latitudes can become very cold in winter. Isotherms over continents swing widely north and south with seasons, while isotherms over oceans move through a much smaller range of latitude.

The global temperature changes from year to year. Within the last few decades, global temperatures have been increasing. Global temperatures are projected to rise significantly if we continue to release large quantities of greenhouse gases. Climatic warming could lead to a rise in sea level, threatening coastal populations, and also cause agricultural patterns and natural ecosystems to shifts in response to changing climatic boundaries. An increase in the number of extreme climatic events has been linked to the change in climate and could increase in the future. The reduction in release of greenhouse gases by world nations is the subject of ongoing international diplomatic activity.

4

Earthen System

Many of the features found on the surface of the Earth, whether on continents or in the oceans are not stable and changeless. There is a definite change, although it may be slow. These changes are continuously occurring both on the surface and beneath the surface. Normally, these changes are very slow, so slow that they are imperceptible but occasionally, particularly when volcanic eruption takes place or when landslides occur, we can witness sudden changes taking place. The surface relief or topography results basically from the action of two types of forces:

A. Endogenic, Endogenetic or Hypogene forces, which give rise to land upliftment, subsidence, folding, fracturing and volcanic eruptions. In general, these forces are responsible for the major structural units of the Earth's surface, for example, mountains, plateaus and plains.

B. Exogenic or Exogenetic or Epigene forces give rise to destruction carving, moulding and smoothening of the major relief features. They produce the intricate details of the surface topography, for example, waterfalls, hills, valleys, spurs, dunes, caves, stacks, etc.

The various types of Earth movements result from the work of endogenetic forces.

Earth's Movements

Endogenetic Movements : Endogenetic Movements (Greek: *'endo'*-within, *'genera '*-origin) fall into two major categories—Diastrophic Movements and Sudden Movements.

Diastrophic Movements : (Greek: *'diastropos'*-turned, twisted, distorted) are those which result directly or indirectly, in relative or absolute changes of position, level or altitude of the rocks forming the Earth's crust. These diastrophic movements lead to the formation of primary landforms. Primary landforms vary in size from continents to miniature Earthquake fault scarps. There are three major classes of diastrophic movements, all of which are interrelated.

(I) Tectonic Movements.

(II) Isostatic Movements.

(III) Eustatic Movements.

Tectonic Movements : Tectonic movements (Greek: *'tekton'*-a builder) includes epeirogenic and orogenic movements.

Epeirogenic Movements : Epeirogenic movements (Greek: *'epeiros'*-land, continent) relate to the behaviour of continental platform or stable blocks involving broad gentle upwarping of relatively large crustal areas. These are vertical movements, caused by radial forces and are characterised by large scale upliftment, subsidence or submergence and emergence of land areas. The movements involved are so slow and widespread that no obvious fracturing or folding is produced in the rock.

Every continent including Antarctica offers unmistakable evidence of both downward and upward movements since Precambrian times. The proof of such movements is found in marine sedimentary rocks of Palaeozoic, Mesozoic and Cenozoic age, which lie within continents upon well-eroded older rocks.

Much of the northern coast of the Gulf of Mexico has been subsiding very slowly for many centuries. Numerous islands off the coast of British Columbia are believed to have been, till recently, part of the mainland since they have submerged there. The seaways between the islands represent lowlands now submerged. Dredging in the North Sea, between England and Norway, which forms part of stable region of NW Europe, and has revealed stumps and roots of trees which once grew on land and that is now beneath the sea.

Movements of greater magnitude are demonstrated by the sedimentary successions built upon continental shelves and within the continents themselves. A vast majestic depression is recorded in the transgressive series of sediments deposited in spreading epicontinental seas as illustrated by Cenomanian transgression which drowned enormous low lying areas towards the end of Cretaceous period. On the continental parts of stable blocks, various types of sediments may accumulate. They include *arkoses* formed by the decay of uplifted mountain masses, aeolian and lacustrine deposits, coal, evaporites and tillites. The Karroo sediments of South Africa provide an illustration of the sequence formed by long continued deposition in the interior of relatively stable continental mass. Where no sedimentary succession have been formed, records of epeirogenic movement may be preserved by features of the surface topography. Lake Victoria and Lake Kyogo in East Africa lie within a shallow basin of recent origin and their sinuous outlines indicate the drowning of land.

True epeirogenic movements involving cratons are possibly due to mantle plume or due to the collision of two continental plates. Local circular elevations can occur as fast as 8 mm per year and these are associated with mantle convection plumes. West of Yellowstone National Park, an area of 8000 km^2 is rising at a rate of 3-5 mm/year. During the period 1955- 73 the central Adirondacks in New York State rose 40 mm whereas the northern margin subsided 50 mm.

The Rhine Massif has been elevated 300 mm since the Pliocene (probably episodically). Contemporary uplift measurement rates of the Massif are 0.35 mm per year. A very characteristic behaviour of cratons is the long continued rise of localised plateaus. The Colorado Plateau seems to have risen about 550 mm in the Late Cenozoic at an average rate of about 0.1 mm per year and the uplift of Deccan plateau of India, during the Tertiary and Quaternary continues at present, at a rate of 0.36 mm per year.

Orogenic Movements : Orogenic movements (Greek: 'oros'- mountain) relate to behaviour of plate margins and involve intense folding, thrusting, faulting and uplift of narrow belts. They are caused by tangential forces acting on the surface of the Earth. These tangential forces belong to two categories—compressional forces and tensional forces.

Compressional Forces

Folding : A fold or buckle, in any preexisting structure in a rock, is a result of deformation. Folds are best displayed by structures that were formerly approximately planar such as layering or bedding in sedimentary and igneous rocks, or foliation, schistosity and cleavage in metamorphic rocks.

If deformation is slight, the nature of the folding is easily described but it may be very complex and a geologist may have to employ careful mapping and measurement of structures in order to work out the nature, extent and age of the folds. Different terms define the various components of folds. The sides of folds are called as the limbs and the median line between the limbs, along the crest of an anticline or the trough of a syncline, is the axis of the fold. A fold with an inclined axis is called a plunging fold. The angle between a fold axis and the horizontal is the plunge of the fold. An imaginary plane that divides a fold as symmetrically as possible and that passes through its axis, is the axial plane.

In broad, open folding, the beds will retain their natural order of deposition, in both the upfolds called anticlines.

A syncline is formed when the strata are bent downwards. These structures in which the stratigraphy is unknown may be called antiforms and forms.

If the axial plane bisects the fold, the fold is said to be symmetrical or upright. If the axial plane has a dip, the fold is described as inclined or asymmetrical.

A sequence of fold structures may be formulated which are related to the degree of compressional forces involved.

Monocline, the simplest of folds, is a one-limbed flexure on both sides of which the strata are either horizontal or dip uniformly at low angles.

The angle between the fold limbs, as seen in profile, is a measure of the tightness of the fold. Folds with narrow hinge zone are described as angular, while if the hinge zone is broad they are described as rounded.

Folds with straight limbs and angular hinges may be described as chevron folds, if the limbs are symmetrical, and kink bands, if the limbs are markedly asymmetrical. Conjugate folds are apparently related folds with converging axial surface. Kink bands may form conjugate sets while conjugate folds with rounded hinges are box folds.

Parallel folds are folds in which the profiles of fold surface lie on arcs of circles. Similar folds are folds in which the thickness of layers is greater in the hinge zone than on the limbs.

In isoclinal folds, both limbs are essentially parallel, regardless whether the fold is upright, overturned or recumbent. An isoclinal fold results from the continued lateral compression upon an overfold crowding it upon the adjacent overfold. Here, both the limbs dip at equal angles in the same direction.

An overturned fold is one in which the strata in one limb have been folded beyond the vertical. Both limbs dip in the same direction, though not necessarily at the same angle.

A recumbent fold is literally a fold lying down resulting from the continuation of pressure, the axial plane and both limbs of the fold are roughly horizontal.

A nappe (French: '*nappe-a* cover) results when the pressure exerted upon a recumbent fold is sufficiently great to cause it to be torn from its roots and to be thrust forward. Nappes are basically large horizontal recumbent folds that have travelled for tens of kilometres along the thrust planes. They are well developed in the Alps and also in the Himalayas. A distinction is made between the autocthonous nappe, denoting rocks that are still in their place of formation and have not been displaced by thrusting, e.g., a folded sequence of rocks whose roots are still connected.

Ailocthonous also called para-autocthonous, in contrast, denotes an isolated mass of rock displaced over a considerable distance from its original source by low angle thrusting. The plane that marks the boundary between two different types of deformation is called decollement. The rocks above are generally deformed, whereas those below may be unaffected. It is caused by the upper rock series sliding over the lower during folding.

Forces of Tension

Faulting : A fault is a fracture, which involves the displacement of blocks on either side of it, relative to one another. In faulting, there is movement of greater or smaller extent along the plane of fracture. Such a movement may be vertical or horizontal or a combination of both.

Most faulting occurs along features that are inclined. Faults can be described according to the attitude of the fault plane and relative displacement of the blocks on either side. The dip of the fault plane is the angle between the fault plane and the horizontal. A dip of less than 45° describes a low angle fault, while a high angle fault has a dip greater than 45°. Where the fault plane is not vertical, the side overlying the fault plane is called the hanging wall and the side underlying the fault plane is the footwall.

Faults are grouped according to:

(i) the inclination of the surface along which fracture has occurred, and

(ii) the direction of relative movement of the rock on its two sides.

Normal Faults are caused by tensional forces that tend to pull the crust apart, and also by the forces tending to expand the crust by pushing it. Upward from below, movement on a normal fault is such that the hanging wall block moves down relative to the footwall block. In other words, normal faults are produced where tension in the Earths crust fractures rock and allows blocks to slip straight down. Normal faults with dip of less than 45° are sometimes known as lag faults or low angle (extension) faults.

Commonly two or more similarly trending normal faults enclose an upthrust. A down dropped block is a graben or a rift, if it is bounded by two normal faults or a half graben if it subsides along a single fault. An upthrust block is a horst.

Rift valleys are among the most dramatic fault features. The Mid Oceanic Ridge (MOR) system, running for about 64000 km, has its crest occupied by a rift valley. Perhaps the worlds most famous system of graben and half grabens is the Great Rift Valley of East Africa, which runs north-south all the way from Israel to Mozambique for a distance of more than 6000 km. The floor of the rift valley is the downthrown block called a graben.

Although none being as spectacular as the Great African Rift Valley, normal faults and graben are very common. The valley in which the Rhine River flows through western Europe follows a series of grabens. The Narmada and the Benue also flow in the rift valley. A parallel series of faults with a repeated downthrow in the same direction is termed step faulting.

A horst is the opposite of a graben and may create huge, high plateaus. The mountains which are remnants of the Hercynian mountain building period, for example, Central Plateau of France, Vosges, Black Forest and Bohemian Massifs are all Block Mountains (in fact, they are relics of old fold mountains which have been denuded and shattered). The Sinai desert in the Middle East and the Ruwenzori Mountains in East Africa are all horst blocks. A horst and graben type of topography is found to be associated with Flinders Mountain and Torrens Valley in South Australia.

Reverse faults arise from compressive forces. Movement on a reverse fault is hanging-wall up relative to the footwall. Reverse fault movement pushes older rocks over younger ones thereby shortening and thickening the crust. Reverse faults are less steep and more varied in angle than normal faults.

A special class of reverse faults are called thrust faults (or thrusts). These are low angle reverse faults with dips less than 45°. Such faults, common in great mountain chains, are noteworthy because along some of them the hanging wall block has moved many kilometres over the footwall block. Thrust faults may be split into a kind of staircase of level sections called flats and step sections called ramp.

A normal or reverse fault on which the only component of movement lies in a vertical plane normal to the strike of the fault surface is the dip slip fault.

Patterns of faults develop according to the stress system involved, and may be parallel, en echelon, radial, concentric, or in two directions (intersecting).

Strike Slip faults (also called tear, transcurrent or wrench faults) are characterised by predominantly lateral (horizontal) movement. Movement of a strike slip fault is described by looking directly across the fault and by noting which way the block on the opposite side has moved. To an observer, standing on one fault block the movement of the other block is left lateral (sinistral) or right lateral (dextral). The sense of relative motion is the same regardless of the block on which the observer is standing. One form of tear fault is the transform fault. Transform faults are largely found on the ocean floor. They cut across and offset the rift zones of Mid Oceanic Ridges throughout the world. The most important surface expressions of transform faults are San Andreas Fault, California; Alpine Fault, New Zealand; the Philippines Fault and the Atacama Fault of Chile.

Oblique-Slip faults have similar magnitudes of both strike and dip slip components of displacement. It is a fault in which blocks of rock slip up and down and past each other diagonally. This occurs when a wrenching movement in the Earth's crust is combined with compression or tension causing blocks of rocks to slip diagonally past each other. If this happens on a massive scale, they are called transtension or transpression faults.

Rotational faults occur where the amount of displacement varies along the fault. The blocks on either side of the fault behave like rigid blocks rotating about an axis at right angles to the fault plane. A hinge fault occurs where a fault dies out and the end of the fault acts as a hinge. A scissor fault or pivot fault occurs where the sense of displacement changes between opposite sides of the axis about which the blocks rotate. There is an axis on the fault plane where no movement occurs; on either side of the axis, the displacement is in the opposite sense so that the action may be compared to opening a pair of scissors. Listric faults are spoon-shaped rotational- faults in which the hanging wall is rotated towards the fault in the same sense as the movement along the fault.

Movement of Isostasy

Isostatic (Greek: 'iso-equal 'statis-standing) movements involve vertical movements under the action of floatation displacement between rock layers of differing density and mobility to achieve balanced crustal columns of uniform mass above a level of compensation in which topographic elevation is inversely related to the underlying rock density. This isostatic movement is best represented by the readjustments, which followed the Pleistocene glaciation.

The formation of the great ice sheet over Scandinavia led to the land being depressed by the enormous weight of accumulated ice. When the ice eventually melted, the land surface began to rise in response to the gradual easing load. This uplift is illustrated by the occurrence of a series of raised beaches. The uplift is continuing and can be illustrated by changes, which have gone along the Bothnian coast of the Baltic, for example, the emergence of Alland Islands from the sea. More land is emerging above the sea and the already emerged islands are increasing in area.

Because of this movement, it is possible that someday the islands may be united in a solid neck of land linking Finland to Sweden transforming the Gulf of Bothnia in a broad land-locked sea. The Finnish port of Vaasa has been in existence for several hundred of years but the modern port lies some six miles of the original harbour site, a fact which illustrated how the continuing uplift along this coast has rendered some of the old harbours quite useless.

System of Material Distribution

The theory of isostasy postulates a system for the distribution of material in the earth's crust which conforms to and explains the observed gravity values.

The theory was developed from gravity surveys in the mountains of India about 1850. A series of measurements were made at different elevations across the mountain range. These observed values were then reduced to what they would have been if the mountains were leveled off and the observation made at sea level. These values were then compared with the theoretical value for gravity at that latitude. The results show that the actual force of gravity over the mountain range is considerably less than it should be theoretically. In fact the difference is so great in some cases that the two values are more nearly the same if the Bouguer correction (which removes the attraction of the rock material between sea level and the point of observation) is not made. This discrepancy between the observed and theoretical values can be explained only in terms of the distribution of rock densities below sea level.

Put simply, the concept of isostasy means that a state of equilibrium or balance exists in the Earth's crust. Moho (the boundary between the crust and mantle) is found deepest beneath the highest mountain ranges and shallower beneath regions of lower surface elevations. For example, the Moho is 80 km deep beneath large mountain ranges, 40 km beneath the continental regions and only 6 km beneath the ocean bottom. This means that the lithosphere is 'floating' on the asthenosphere with more massive portions reaching deeper to obtain needed buoyancy. It can be understood thus—a massive block of ice will extend deeper into the water than a small ice cube. Its top side will be projecting into the air proportionately. If several blocks of wood of the same cross section but of differing height are floating in a tank of water, each of the different blocks raises itself above the water level by an amount, which is proportional to its length. A series of such blocks are in a state of hydrostatic equilibrium. Likewise differences in density may also be responsible for such hydrostatic balance. Lighter density materials have a tendency to rise high. Thus mountains which are composed of lighter materials than the surrounding lowlands are high.

Now if an inch was sawn off one of the blocks, that particular block would adjust itself by rising in the water and a part of the block previously submerged would adjust itself above the water level while the block would not sink as much as it originally did. Loss of material and thus, weight by denudation of a landmass will upset the equilibrium of the landmass and cause it to rise until equilibrium is reached. If any additional weight is added to the landmass, such as a pile of volcanic material on the oceanic crust, it can make the crust subside, or accumulation of ice will also tend to depress the landmass. This process must involve some compensatory lateral flow of material at depth in the mantle, i.e., there must be lateral flow from beneath the sinking column to under the rising column.

Density Distribution Theories

Two systems of density distribution were set forth by Airy and Pratt in 1855. These two theories have been modified very little since their presentation, and their relative merits are still debated. A third such type of theory was put forward by Heiskanen.

Airy Theory : Airy postulated that there is a change in the density of rocks at depth in the earth's interior and that the upper lighter material floats on the more dense part, which behaves like a fluid. The depth of this change varies from place to place. Under mountains the depth is greater than under oceans or plains. In other words the mountains have roots of light-weight materials which extends down into the lower, more dense mantle rocks. The lower density (mass) of the roots causes the observed gravity values measured in the mountain ranges to be lower than predicted theoretically.

Pratt Theory : Pratt's theory differs from Airy's in that Pratt assumed that the boundary between the upper light material and the lower dense rocks is at a uniform depth, called the depth of compensation. He further postulated that there are variations in the density of the lighter layer, which are related to the elevation of the surface. Lighter material lies under mountains, and heavier material under oceans. The weight of columns of rock extending from the surface to the depth of compensation in different parts of the earth is thus the same. Gravitational studies offer no means of determining which of these theories is more nearly correct. It is possible that neither is absolutely correct, but evidence from other geological studies suggest that Pratt's theory comes closer to fitting all the facts we have. Seismic studies indicate that more dense material underlies ocean basins than continents. These observations support Pratt's assumption of a connection between density and elevation.

Heiskanen's Theory : Airy postulated that columns of rock are nearly the same in density, floating like blocks in a fluid, Pratt suggested that different segments of the earth are of different densities, but that the differences are compensated at a certain depth. A third hypothesis has been formulated by Heiskanen (1933). He combines the assumptions of both Airy and Pratt. It has been observed that rocks at sea level are more dense on the average than those at higher elevations (2.76 grams per cm^2 at sea level down to 2.70 gm/cm^2 at elevations in high mountains). He assumes that this change continues downward, tending to make deeper rocks more dense than shallower ones in all sections of the earth's crust, In addition, different sections are thought to have different densities and different lengths. Heiskanen's theory has the advantages to being based on actual knowledge of density variations that can be obtained by direct measurement, and when it is applied to the observations we now have on the gravitational field it yields very low anomalies.

Changing Phase

The alternative explanation of vertical movements is phase change. Some materials, when subjected to considerable pressure, change their atomic and crystal structures and compact themselves into a smaller space, i.e., they undergo phase change, Olivine, which forms a large proportion of mantle material, behaves in this way.

Thus, at a certain level in the mantle, where critical pressure is reached, a phase change occurs and a phase change boundary can be drawn in. If erosion occurs, the pressure on an area of the Earth's crust is decreased, and the phase boundary line moves downwards in position (i.e., the critical pressure for change is not attained until a greater depth is reached). This means that some of the mantle material is changed from a high density to a low density form and consequently increases in volume. This, in turn, causes an uplift of rock column above it. Conversely, loading by ice, sedimentation, piling of volcanic material at the Earth's surface produce an upward movement of the phase change boundary, a compaction of some of the mantle material and a resultant sinking of the rock column above.

Isostasy and Denudation

Since the rate of denudation is functionally related to relief and the latter is reduced through time, it is possible to calculate, on the basis of the above relationship, that after 11 m.y. landmass would be reduced to 10% of its original relief and after 22 m.y.

it should be reduced to 1%, as the rate of denudation declines both with time and relief.

Denudation rates, however, refer only to material stripped from the continental surfaces. In considering destruction of relief we must also take into account isostatic rebound, as the gradually thinning continent becomes more buoyant on the underlying mantle. Isostatic rebound can be calculated thus:

$$h = Br/A$$

where, h = isostatic compensation,

B = specific gravity of surface rocks removed.

A = specific gravity of material replacing at depth, and

r = thickness of surface layer removed.

assuming A = 3.4 and B = 3.6 then h = 0.76 r.

Assuming then, that isostatic rebound, in response to erosional losses, is a continuous and widespread process, then three-quarters of the relief removed within a given period of time is replaced. Accordingly, the real length of time taken for the destruction of the relief of a land mass will be longer, and it is calculated that, with isostatic compensation, 18.5 m.y. will be required for reduction of 10% of initial relief and 37 m.y. of 1% reduction.

Eustatic Movements : Eustatic Movement (Greek: 'ew'-well, '*statis*' -standing) involves the world wide movement of sea level resulting from changes in the total volume of liquid sea water and the capacity of the ocean basins. For example, rapid convection in the mantle would arch up the oceanic ridge and displace water from the ocean basins to the continents as the capacity of the ocean basin decreases. If the convection rate decreased, the oceanic ridges subside and the seas would recede with a fall in sea level. As the plates move, the sea level rises and falls slightly and thus causes expansion and contraction of shallow seas over the cratons. If the continental mass gets arched up, there is a general withdrawal of sea.

Sudden Movements : Sudden movements include Earthquakes and Igneous movement.

Cause of Earthquakes

Earthquakes are vibrations or oscillations on the surface of the Earth caused by the rupture and sudden movement of rocks that have been strained beyond their elastic limit.

The upper part of the Earth's crust and upper mantle (lithosphere) are very strong and brittle. But when this rock is subjected to deformation, the rock actually bends elastically. The rock is able to withstand only slight stress with only slight bending or strain. Continued stress leads to the building up of strain up till a point.

This is the elastic limit of the rock. If the rock is strained beyond this limit, a fault is formed and the bent rock snaps up to regain its original shape releasing the stored energy in the form of rebounding and violent vibrations. These vibrations shake the ground even hundreds of kilometres away. The shaking is strongest along the fault.

When the vibrations are felt in the bedrock and ground, they are called shocks. The point within the Earth where Earthquakes are generated is called focus. The point on the Earth's surface directly above the focus is called the epicenter. Earthquake focus can be shallow (up to 70 km depth) known as shallow focus earthquake, between 70 km and 300 km it is known as intermediate focus earthquake and the focus below 300 km up to 700 km is deep focus earthquake.

Effect of Earthquakes : The dangers of earthquakes are profound and the damage they do is catastrophic. Their effects are of two types—Primary and Secondary. Primary effect cause damages directly and includes ground motion and faulting; secondary effects cause damages indirectly as a result of process set in motion by the Earthquake.

Primary Effects

1. Ground motion results from the movement of seismic waves, especially surface waves, through surface rock layers and regolith. The motions can damage and sometimes completely destroy buildings.

Where a fault breaks, the ground surface buildings can be split, roads disrupted and any feature that crosses the fault can be broken apart. The 1906 San Francisco Earthquake led to the visible displacement along the San Andreas Fault. Horizontal displacement occurred over a distance of about 400 km and offset roads, fences and buildings by as much as 7 m.

Secondary Effect

1. In regions of hills and steep slopes, Earthquake vibrations may cause regolith to slip, cliffs to collapse, and other rapid mass-wasting movement to start. This is particularly true in Alaska, parts of southern California, China and hilly places such as Iran and Turkey.
2. The sudden shaking and disturbance of water saturated sediments and regolith can turn seemingly solid material to a liquid like mass, such as quick sand. This is called liquefaction and it was one of the major causes of damage during the earthquakes that destroyed much of Anchorage, Alaska, 1064.
3. Seismic sea waves occur following violent movement of the seafloor. Also called Tsunamis, they occur particularly in the Pacific Ocean.
4. Earthquakes can cause fire by breaking gas lines and snapping electric wires.

Important Terms

Anticlines
Axial plane
Box folds
Chevron fold
Cleavages
Diastrophic Movement
Earthquakes
Endogenetic Movement
Endogenic
Epeirogenic Movement
Epigene
Eustatic Movement
Exogenetic
Exogenic
Footwall
Hanging Wail
Horst
Hypogene
Kink bands
Linear structures
Monocline
Nappe
Normal Faults
Oblique-slip fault
Overturned fold
Parallel folds
Isoclinal folds
Plunge
Plunging fold
Recumbent fold
Reverse fault
Rift valleys
Rotational fault
Step faulting
Strike-slip faults
Symmetrical
Tectonic Movement
Transcurrent fault
Wrench faults

5

Formation of Earth

Earth Crust

The Earth is composed of three layers—the crust, mantle and the core. The crust is the outermost layer, mantle the intermediate layer and core is the innermost layer. The crust of the Earth is seismically defined as the solid Earth above the Mohorovicic discontinuity or in short, simply Moho. The crust is thin, rocky veneer that constitutes the continents and the floors of the oceans, and is not a homogenous shell. There are two distinct kinds of crust, which, because of their distinctive compositions and physical properties, determine the very existence of separate continents and ocean basins.

Nature of the Crust

The crust is very thin, averaging only about 33 km in thickness. Compared to its lateral extent, the thickness is only of a very minuscule proportion. When examined by geological and chemical techniques, the rocks exposed at the land surface show great heterogeneity and regional variation. For example, the younger margins of continents consist largely of sediments derived from the continued erosion of the continental surface and transported to the coast, where most of it is deposited in shallow water on the continental shelf. Such sediments may form accumulations many kilometres thick. On the other hand, the oldest continental regions, the Precambrian Shields are often dominated by igneous rocks such as granite or by highly metamorphosed rocks such as gneiss. Even within a restricted region of a few square kilometres, great changes are likely to occur in chemical composition, e.g., from granite to basalt or gabbro or even to ultramafic rocks, such as peridotite. Among sedimentary rocks, the chemical differences may be even greater. Sedimentary processes are even more effective than igneous ones in causing the sorting out or separating from one another of chemical components.

The more recent calculations of the composition of the Earth's crust are based on estimates of the relative volumes of the different types of sedimentary, igneous and metamorphic rocks and the composition of each. It can be seen that the composition of the whole continental crust is intermediate between granite and basalt. Estimates of the composition of the granitic layer alone indicate that in fact this is not granitic, but is also intermediate in character. Every rock can be assumed to contain each of the naturally occurring elements, though perhaps only at extremely low concentrations. Some of these abundant 'trace' elements are relatively uncommon in everyday use, while many of the metals of importance to society are extremely rare in nature.

The composition of some types of sedimentary and igneous rocks and of the continental crust might suggest at first sight that silicon is the dominant element in the Earth's crust. This is not true. If the analyses are recalculated to show the concentration of each element instead of its oxide, it is seen that oxygen is the major constituent (46.5%) of the Earth's crust, with silicon at second place. This superiority of oxygen is even more enhanced if the relative numbers of atoms of each element are calculated. Nearly two-thirds of the atoms of the Earth's crust are of oxygen.

On a volume basis, oxygen is 94% of the Earth's crust. The relatively tiny silicon ions, each of which is only about a fortieth of the volume of an oxygen ion, make up less than 1% of the volume of the crust. In effect, silicate minerals can be thought of as a stack of framework of oxygen ions, with the other much smaller ions fitting into the interstices and spaces between.

The densities of the crustal material are generally in the range of 2.5 to 3.3 g/cm^3. This makes them denser than water but less dense than materials beneath them. Thus, they would sink in water but float on the materials beneath it. The thickness of the crust varies and it can be known by the depth of the Moho, which is the deepest beneath regions of higher surface elevations. For example, the Moho reaches depths of about 70 km beneath large mountain ranges, 40 km beneath more common continental regions and only 6 km beneath the ocean bottom. Thus, the Earth's crust is composed of relatively light rigid materials than the denser, warmer, less rigid mantle materials beneath. In addition to the crust, the portion of the mantle just beneath the Moho is also rather cool and rigid as shown by seismic waves travelling through it. The upper cooler portion of the mantle, which encompasses the upper 80 to 100 km, sticks to the bottom of the crust and moves along with it. This combined rigid outer region is called the lithosphere (Greek: 'lithos -rock). Beneath the lithosphere, from 100 to 200 km depth, is the Low Velocity Zone (LVZ), which is much softer than the lithosphere. The prevalence of high temperature here means that some minerals are in a molten phase. This more plastic region of the mantle, which is largely composed of peridotite and on which lithosphere floats, is called the asthenosphere (Greek: *'asthenos'-weak)*.

The lithosphere is floating on the underlying asthenosphere. The massive portions of the lithosphere reach deeper to obtain the needed buoyancy. This floating lithosphere can be compared to a massive block of ice which extends deeper into the water while its top side extends proportionately higher into the air. Likewise, the lithosphere begins to sink in the asthenosphere when a weight is placed over it. Such an increase in the load may happen when a volcano grows or when the land is covered under a thick ice sheet. The adjustments which are required to obtain buoyant equilibrium is called isostatic adjustments and the condition of buoyant equilibrium is called isostasy. The condition of isostasy is best exhibited where massive portions of the lithosphere reach deeper into the asthenosphere to obtain the required buoyancy. Were it not for isostasy, mountain ranges would have gradually subsided because there are no rocks strong enough to bear the heavy load of mountain ranges. The mountains are not supported by the strength of the crust but rather are in a state of floatational equilibrium with the denser underlying rock.

Composition and Structure of Continental Crust : The Earth is the only terrestrial planet, which has a continental crust. Continents cover roughly about one-third of the planet. They are mostly concentrated in the Northern Hemisphere and are roughly triangular in shape. Continental crust range in thickness from 30 to 50 km. The depth of the Moho beneath the continents averages about 35 km, although the crust may be considerably thicker or thinner in particular regions. The thickest portion of the continents is found beneath mountain ranges. Continental crust has a density ranging from 2.5 to $2.7 g/cm^3$ and this density conforms to the nature of rocks found on the continents. Although, the continental crust is referred to as being 'granitic', it is actually an assortment of various rocks which, if all melted together, could be converted to granites or more specifically granodiorite. Basically, the structure of continental crust comprises three layers—

(i) *Upper sedimentary layer.* The continental sedimentary sequence rarely exceeds a few kilometres in thickness except in narrow, deeply subsiding tracts where the sediments accumulate to thicknesses in excess of 15 km. These sediments may be absent, particularly where the ancient magmatic and metamorphic rocks come out on to the surface, such as in the Baltic shield, the Aldan shield, the Anabar massif, etc.

(ii) *Granitic layer.* Much of the continental crust is composed of metamorphic rocks of the same composition as granite. Continents mostly consist of a highly complex sequence of metamorphosed sediments and volcanic rocks, together with large volumes of granitic intrusions and granitic gneiss.

(iii) *Basaltic layer.* Below the granitic layer is the basaltic layer. At some places the transition from granitic to basaltic layer is gradual but at some places, it is fairly clear (known as Conrad discontinuity). This layer has a higher density compared to the upper layer.

One of the most important characteristics of igneous continental rocks is that they are relatively richer in silicon and potassium and poorer in iron, magnesium and calcium. These continental rocks are also the oldest rocks on the Earth and are as old as 3.8 billion years.

Geological Features

In terms of basic geological character the continental crust can be divided into two types of regions—cratons and orogenic belts. Geological differences among continents are mostly in the size, shape and proportions of the two components.

The Cratons : Cratons (Greek: 'Aratos'-power, strength) are extensive flat stable regions of the continents in which complex crystalline rocks are exposed or buried beneath a relatively thin sedimentary cover. These regions have not been affected by any Earth movements for over a half billion years, except for broad gentle warping. These cratons include the shields, where large areas of highly deformed igneous and metamorphic rocks, the basement complexes are exposed. These stable platforms are stable regions of the crust covered by essentially horizontal sedimentary strata.

Shields : Shields are a regional surface of low relief having an elevation within a few hundred metres above sea level. Shields are broadly convex and relatively immobile regions, usually constructed of Precambrian metamorphic and igneous rocks.

The gentle, low relief is broken by resistant rock formations that rise a few tens of metres above the surrounding less resistant rocks. On a regional basis, shields are flat, slightly convex and almost featureless.

Shields are composed of a highly deformed sequence of Precambrian metamorphic rocks and granitic intrusions known as basement complexes. Most of the rocks are of the Precambrian age and are formed under conditions of high temperature and pressure, many kilometres below the surface. These rocks are traversed by faults and joints expressed at the surface by linear depressions. The sedimentary volcanic rocks of the shield are highly deformed and as such has been converted to complex metamorphic rocks. These rocks were at a later stage intruded by granitic magmas. The upper cover of sedimentary and metamorphic terrain has been removed by erosion, exposing what we now see at the surface. These complex igneous and metamorphic rocks form the nucleus of every continent.

Shields of the World : Although, Precambrian exposures are common in cores of mountain ranges and canyons of plateaus, the most obvious and largest areas of Precambrian rocks are the erosionally stripped, regionally upwarped, geologically stable regions of the continents. These regions are called Precambrian shields because of their broadly convex shape (after Greeco-Roman shields). Although, shield rocks are exposed over only about 20% of the Earth's land surface, they represent about 75% of the observable time span accounted for by crustal rocks. Every continent has one or more Precambrian shields rimmed by Phanerozoic mobile belts.

The Indian Shield : The Indian shield is the most important geological region of India, apart from the Himalayan region and the Gangetic plain. There are a number of recognisable separate provinces in the Indian shield. The oldest is the Dharwar Province (2.4 b.y.), which acted as a nucleus around which other provinces became attached. It is predominantly granitic in character with intrusions of gneises and is exposed along the eastern side of the Indian Peninsula. Towards the northeast is the Eastern Ghats province, which is (1.6 b.y.) composed of similar rocks. The Satpura province, which lies at its northeastern edge stabilised about 1000 million years ago. Northeast of Satpura is the Aravalli province, again composed of crystalline rocks while the Vindhyan province contains stratified shales, sandstones and limestones resting unconformably over the Precambrian basement. Over 500,000 sq.km of the Indian Peninsula is covered by early Cretaceous-Cenozoic basalt.

The African Shield : Africa is basically a vast platform of abutting shield segments. Precambrian rocks are exposed over half the surface of Africa and elsewhere lie beneath the layer of Palaeozoic and Mesozoic rocks. It is a stable continent with only its eastern edge having been affected by epeirogenic movements producing faulting and fracturing, manifested in the African rift valleys.

The Early Precambrian events (before 2600 m.y) are found in the Berberton Mountain Land of South Africa, Transvaal and Rhodesian volcanic and granitic intrusion (2.6 and 3.1 b.y) that constitute the crystalline basement of South Africa. The

Middle Precambrian, which began about 2.6 b.y ago and ended 1.1 to 1.8 b.y. ago, led to the evolution of four stable crustal segments. These are the West African bulge, two of which are in Central Africa and the remaining two are in South Africa. Quartzites, shales, conglomerates and lavas characterise the Middle Precambrian rocks.

The Late Precambrian phase of Africa is characterised by the deposition of sedimentary rocks and widespread orogenies in the regions that bordered the old crustal segments. Strips of metamorphosed granitic crust formed between the segments welded them into a unified shield.

The South American Shields : There are three shields in South America—the Guianan, the Brazilian, and the Patagonian Shield. Gneises and schists form the oldest sequence, i.e., Early Precambrian. The Middle Precambrian consists of metamorphosed sediments, volcanic intrusions, and although metamorphic effects are less profound in the Late Precambrian, slates and phyllites are still evidenced along with quartzites, conglomerates, volcanic flows and ash beds.

Because of the presence of a covering of younger sediments over parts of the shield as well as dense forests that cover many regions, the Precambrian rocks of South America are still little known in comparison to the relatively barren shields of Canada and Scandinavia.

The Angaran Shield : The Angaran shield is not exposed over a vast region, instead it is revealed as small exposed patches that elsewhere are covered by younger sedimentary rocks of the Siberian Platform. This shield forms the nucleus of Asia as it is around this shield that Asia has grown. The Himalayas and the Urals have actually got welded on to this shield.

Like the Precambrian or other shields, the Angaran Shield too has an older complex of gneises, schists and granites and also a younger sequence of sedimentary rocks, volcanic and granitic intrusives that date back to about 1600 m.y. ago. These have been called Riphaean.

The most extensive exposure of Precambrian rocks, forms the surface of the Baltic shield. There have been four major episodes of mountain building in the Precambrian history of the shield. In each of these episodes, there were accumulations of great thickness of sediments, which were later subjected to severe compression, metamorphism and massive granitic intrusion.

In the first two episodes, schists and gneises were formed followed by greenstones, slates, ripple marked sandstone and dolostones. In the third phase, the youngest consists of lavas and sandstones that were later intruded by granite.

The Canadian Shield : The Canadian Shield extends from the Arctic islands southward to the Great Lakes area and westward to the plains of western Canada. Most of the Canadian Shield is less than 300 m above sea level. The Canadian Shield represents the first stable and resistant granitic crust in North America. This shield was 20% to 60% larger in the past than at present because the trends of the metamorphic structures were terminated abruptly by younger provinces.

The rocks in the younger province were also metamorphosed but the original sediment was quite different from the sediment that formed in the earlier one. The concentric pattern of the provinces is a strong evidence that the continents grew by accretion of material around its margins.

The Australian Shield : Structurally Australia is composed of a vast Precambrian shield occupying most of the central and western parts of the continent. Mobile belts occur along the eastern part of the continent. As in other shields, the Precambrian surface is partially covered by younger sedimentary rocks. The most remarkable feature of the Australian Precambrian is the presence of thick sequences of relatively unaltered sedimentary rocks spanning over 1.5 b.y. The Australian shield comprises two regions— Archean group comprises igneous and metamorphic rocks over 2.5 b.y., represented by two episodes of mountain building. The Proterozoic rocks rests over worn roots of Archean Mountains. It consists of three great systems of quartzitic sandstones, basaltic lava flows and siliceous rocks.

The Antarctican Shield : Most of the eastern half of Antarctica consists of Precambrian shield. Archean rocks occupy the most extreme eastern edge while Proterozoics occupy remainder of the shield. Most of the western part of Antarctica consists of fold belts of Late Cretaceous and younger age.

The belts of metamorphic rocks together with igneous intrusions shows that shields are composed of a series of zones that were once mobile and tectonically active. Great mountain ranges once traversed parts of the shield but the mountains have since then got eroded and only the roots of these old ranges remain.

Different Platforms

Platforms or stable platforms are those regions of the craton that are stable and consist of an underlying basement of ancient crystalline rocks covered by an essentially horizontal sedimentary strata. These areas have been relatively stable throughout the last 600-700 m.y., i.e., they have not been uplifted or submerged below sea level. The stable platforms form much of the broad flat lowlands of the world.

The rocks, although lying perfectly horizontal, locally seem to be warped into broad shallow domes and basins on a regional basis. The rocks, which cover the basement, are dominantly sandstone, shale and limestone, which were deposited in the ancient shallow seas and later reemerged. This may have been by marine transgression and regression associated with plate movement.

Evolutionary Belts

Orogenic (Greek: *'oros'*-mountain, *'gen'*-production of) belts are the mobile belts arranged in linear or arcuate tracts that have been subjected to severe deformation and mountain building. These belts are typically found near the edges of the continents. Some mountain belts are still in the process of formation. Examples of such mountain belts are the Rockies, Andes and the Alpine-Himalayan chain (extending into Asia and northern Africa). In other mountain belts, deformation ceased long ago but there still exists considerable topographic relief. These include the Appalachian Mountains of the eastern United States of America, the Great Dividing Range of eastern Australia and the Ural Mountains of Europe.

There are two significant aspects related to the location of orogenic belts:

(i) The young fold mountain belts are found along the continental margins. This implies that their formation is the result of the concentration of forces along the margins of continents and not from a uniform worldwide force evenly distributed over the Earth.

(ii) Many older mountain belts extend to the ocean and abruptly terminate at the continental margins. The northern Appalachian of the eastern United States, the Scottish Mountains and Atlas Mountains terminate at the continental margins. This suggests that these mountains were continuous long before and since then have got separated by continental rifting.

The Plains

Plains are flat areas with hardly any relief. They may be extensive, such as the Ganga, Brahmaputra, Amazon, Mississippi and Nile plains; linear or arcuate such as the coastal tracts; swampy, such as the deltaic plains of Sunderban, Mississippi, Orinocco, etc.; and, such as the desert plains of Mojave, Simpson, Sahara, Thar, Indus, etc. In fact, plains can be of an amazing variety and they can be classified according to shape, geographical location or origin. Genetically, plains can be either of volcanic origin, degradational or aggradational, fluvial, glacial, arid, marine or karst.

Structure and Composition of Oceanic Crust : The oceanic crust is approximately 5 to 12 km thick and has an average density of 3.0g/cm^3. The most important characteristic of the structure of the oceanic crust is its remarkable uniformity. There is a surface layer of marine sediments overlying igneous rocks, which form three distinct layers.

The upper sedimentary layer (Layer 1) varies considerably in thickness and composition. This layer consists of calcareous and siliceous shells of microscopic marine organisms together with red clay. The three igneous layers are each of uniform composition and thickness. The upper layer (Layer 2) consists of basaltic flows, which are 1 to 2.5 km thick. These basaltic flows are pillow shaped and were originally fed by numerous fissures. Later these basaltic flows solidified into dykes in the vents and fissures. The pillow lava represents the eruption of volcanoes on the sea floor. Layer 3 almost entirely consists of dykes.

Layer 4 consists of coarse-grained gabbro. Below the gabbro are peridotites composed almost entirely of olivines and pyroxenes. This material is considered to be a part of the mantle. The boundary between the crust and the mantle is called the Moho. Oceanic crust has a concentration of relatively heavier common elements such as iron magnesium and calcium.

Ocean Bottom Relief

The average depth of the seas is almost 3790 m compared with the average elevation of the land, that is, just 875 m. The highest peak on the continents, Mount Everest has an elevation of 8848 m, compared with a depth of almost 12,000 m for the greatest oceanic deep, the Mariana trench of the Pacific Ocean. In all, the depths of the seas are so much greater than the elevation of the continents that the average of the entire Earth's surface is almost 2430 m below sea level. The entire vertical distribution sequence can be better understood by means of a hypsographic or hypsometric curve.

The major elements of the ocean floor are:

Continental Margins

Continental shelf

Continental slope

Continental rise

Ocean Basin Floors

Abyssal floor

Seamounts and Guyots

Inactive rise

Ocean Ridges and Rises

Ocean Trenches

Island Arcs

Marginal Ocean Basins

Plateaus

Ocean-ridge flank	500-1500 km	<1 km	>3km
Ocean-ridge crest	500-1000 km	<2 km	2-4 km

Continental Margins : Continental margin comprises of—Continental Shelf, Slope and Rise.

Continental Shelf

Geologically speaking, the continental shelf is not a part of the oceanic crust. This is because the continental shelf is composed of continental crust and sediment derived from the erosion of relief features on the land. The continental shelves are covered by the oceans and therefore, form a part of the ocean bottom relief. The continental shelf can be called a submerged part of the shield or the stable platform. The continental shelf has an average width of 78 km and an average maximum depth of 133 m. The depth ranges from 20-550 m at the edge of the continents and the width ranges from zero to almost 1500 km. The continental shelf is smoother than the flattest surfaces exposed on land since the average gradient is only 0.1 degree.

The continental shelf is smooth and flat but a detailed examination of the shelf does reveal some relief. On about 60% of the surface, there are low hills with a relief of 18 m or more, 35% of the shelf surface is marked by shallow basins or valleys having a relief of more than 18 m.

Only 30% of the present shelf area is covered with recent marine beds. Two percent of the area of the continental shelf is covered by terrestrial deposits laid down about 25,000 to 10,000 years ago on the river and coastal plains. This was because the greater part of the continental shelves was dry land during the glacio-eustatic marine regression in the last glaciation. At that time, broad expanses of lowland favoured the development of flood plains, delta plains and marshlands.

Continental Slope

Like the continental shelf, the continental slope is also not a part of the oceanic crust. Continental slopes are basically continental margins covered by the ocean. The continental slope descends from the outer edge of the continental shelf as a long continuous slope to the ocean basins. The continental slope marks the edge of the continental granitic rock mass and thus, defines the boundary between continental and oceanic crust. The continental slope is basically the topographic expression of the geologic difference between the continental crust and the oceanic crust reflecting a fundamental difference in the structure and rock type.

Continental slopes are by far, the longest and the highest slopes on the Earth. The slope itself may be straight or smoothly curved or regionally interrupted by one or more platforms. Generalised slopes near the continental break range from 1 to 10°, averaging about 4.3°. The general gradient decreases as the slope merges with the deep sea floor at depths of about 3000-4500 m. The continental slope is steepest where mountain ranges border the coast (4-6°) and where faults demarcate the shoreline (5-6°). Continental slopes are very gentle opposite major deltas (1.3°) and stable coasts (2-3.5°).

The surface of the continental slope is not smooth. Numerous submarine canyons and furrows result in a large relief, and in many places the slope is marked by hills and ridges.

Submarine Canyons of the World

Pacific Ocean	*Atlantic Ocean*	*Indian Ocean*
Tokyo Canyon	Oceanographer Canyon	Indus Canyon
Bering Canyon	Hudson Canyon	Ganges Canyon
Columbia (or Astoria) Canyon	Wilmington Canyon	
Juan de Fucca	Norfolk Canyon	
Monterey Canyon	Congo Canyon	
Arguello Canyon	Sao Francisco Canyon	
Scripps Canyon	Mississippi Canyon	

In places especially opposite large rivers, such as the Congo and the Hudson, the continental shelf and slope are cut by submarine canyons-exhibiting seaward slopes, bifurcation and sinuosities analogous to subaerial rivers. The steep sided canyons are of many sizes (width 1-15 km, lengths 20-2000 km, gradients 1:40) and are partly drowned features resulting from erosion by density or turbidity currents. Turbidity currents lead to the formation of deep sea fans. These fans are located at the base of continental slopes with their apex at the mouth of a submarine canyon cut into the edge of the shelf. The chief source of sediment for the formation of the fan is mud, which is brought by rivers. These sediments are intermittently flushed through the canyon leading to the formation of fans where the currents reach the lower gradients of the ocean floor.

Many fans have deep channels, which are an extension of the submarine canyons cut in the continental slope. The channels develop natural levees analogous to stream natural levees on land. The greatest fans are found beyond the Ganges and the Indus delta. Other large fans are the Amazon and the Congo fans in the south Atlantic, Mississippi fan in the Gulf of Mexico and the Laurentian fan in the north Atlantic. Large fans are absent in the Pacific because most of the important rivers drain into the Atlantic and Indian oceans, and the deep marine trenches trap most of the sediment that flows into the Pacific.

Continental Rise : At the base of continental slopes, the slope decreases to 1° or less continuing into the abyssal hill or plains. From this decrease in slope onwards begins the continental rise. This is also a part of the continental crust.

Ocean Basin

The ocean basins are composed of—the abyssal floor, technically inactive rises and seamounts. Broad, relatively smooth surfaces are known as abyssal floors. The abyssal floor extends from the continental margins to the oceanic ridges at a depth of about 3000 m. The abyssal floor consists of two sections—the abyssal plains and the abyssal hills.

Abyssal Plains : Abyssal plains are tectonically inactive areas of very less slope with gradient less than 1:1000. They have almost no relief as they are 1000 km wide and are situated at depths of 3-6 km. The flatness is due to the accumulation of fine sediments up to thickness of 1 km burying most relief features. The plains are covered at their centres by some 300 m of sediment which thickens towards the continental rise, slope and shelf. Generally, abyssal plains are located near the margins of continents where sediments from continental mass are transported by turbidity currents and spread over adjacent ocean floor.

Abyssal Hills : The abyssal hills are relatively small hills rising from 50 to 1000 m. They are up to 100 km wide and are circular or elliptical in outline. Abyssal hills appear to be associated with ocean ridges which are, in some places, parallel particularly in the Atlantic and occur in profusion in parts of the ocean floor separated from land by trenches. In the Pacific, abyssal hills cover between 80% and 85% of the ocean floor.

Seamounts and Guyots : Seamounts and Guyots are isolated submarine volcanic features 2-100 km wide and more than 1000 m high whose surfaces lie less than 2000 in below sea level. Many seamounts and guyots, when they rise above sea level, form volcanic islands and among these, Hawaii and Azores are most notable. Many seamounts are sharply pointed but others are flat-topped hills whose summits lie more than 200 m below sea level. These flat topped seamounts are called guyots and there are about 1400 guyots in the Pacific alone.

Guyots have steep sides (12°-35°) and are considered to be leveled platforms, submerged largely by sea floor subsidence and also by the post-glacial rise in sea level. There is one strong evidence supporting this view. Guyots are commonly capped by coral growth in the tropics, which could not have been built at depths greater than 150 m.

Ocean Ridge

The oceanic ridge is the most pronounced feature on the Earth covering nearly 23% of the Earth's surface. This area is almost as large as the surface of the continents. An oceanic ridge is a broad transversely fractured linear swell lying mostly near the centre of oceans. The Mid Atlantic Ridge is the largest and the best known ridge whose highest part extends well above the sea level to form the Azores, Ascensian and other islands.

Other well known ridges are the Carlsberg ridge in the Indian Ocean, the East Pacific ridge in the Pacific Ocean, the Lomonosov ridge in the Arctic Ocean and the Pacific Antarctic ridge between Antarctica, New Zealand and Australia. The broad characteristics of oceanic ridges are:

1. They are more than 1500 km wide and rise 1-3 km over the ocean floor.
2. They are continuous features around the entire globe extending from Arctic basin down through the centre of the Atlantic into the Indian Ocean and across the south Pacific before ending in the Gulf of California. The total length of the continental ridges is more than 84000 km.
3. A rift valley marks the crest of the ridges throughout their length.
4. The oceanic ridge, throughout most of its length, is cut by a series of transform faults.

The main difference between ridges and rises is that ridges are steep sided while rises, such as the East Pacific rise, are gentle sloped.

Ridges and rises can be both active and inactive. In active ridges and rises there is continued volcanic and seismic activity while inactive aseismic ridges and rises are devoid of any earthquake or volcanic activity. Ridges and rises are mostly arranged in the form of a linear chain of extinct volcanoes and are indicators of past plate movement. The most important aseismic systems are the Galpagos rise, the Rio Grande rise, the Hawaiian and the Austral Marshall Gilbert chain.

Ocean Trench

Along some coasts, e.g., the western Pacific Ocean, eastern Indian Ocean and the Caribbean sea, the continental shelf drops steeply into trenches, forming the deepest part of the oceans. These trenches are 30-100 km wide and 300-5000 km long.

Their sides slope first at angles of about 4-8° and then at 10°-16° to depths of more than 10,000 m. The walls are in the form of steps, which may have been formed by the slumping on young mountain belts on their seaward side. These are characteristically V-shaped with narrow flat floors up to several kilometres wide.

They are covered by a very thin layer of sediments. Examples of trenches are—the Mariana trench of Philippines, the Java trench, the Aleutian trench, the Japan trench, the Puerto Rico trench, the Peru-Chile trench, etc.

Characteristics of Trenches

Trench	*Depth (km)*	*Length (km)*	*Avg Width (km)*
Pacific Ocean			
Kurile-Kamchatka Trench	10.5	2200	
Japan Trench	8.4	800	100
Bonin Trench	9.8	800	90
Mariana Trench	11.0	2550	70
Philippine Trench	10.5	1400	60
Tonga Trench	10.8	1400	55
Kermadoc Trench	10.0	1500	40
Aleutian Trench	7.7	3700	50
Middle America Trench	6.7	2800	40

Peru-Chile Trench	8.1	5900	100
Indian Ocean			

Contd...

Trench	*Depth (km)*	*Length (km)*	*Avg Width (km)*
Java Trench	7.5	4500	80
Atlantic Ocean			
Puerto Rico Trench	8.6	1550	120
South Sandwich Trench	8.4	1450	90
Romanche Trench	7.9	300	60

Volcanic Zone

Island arcs are chains of volcanic islands. These islands are generally convex towards the open ocean (hence they are called arcs) and run parallel to the ocean trenches and mountain chains.

Island arcs range in size from less than 1 km to as large as Guinea, Luzon or Hokkaido. These are seismically active and are topographically and structurally continuous with some continental belts of young folded mountains (e.g., Malaya, Kamchatka, Alaska), which they strongly resemble. Each island arc is generally made of the parallel arcs of island 50-150 km apart.

The outer arc is dominantly composed of folded and thrust sediments and lacks forms. It may be submerged, e.g., Ryukyu Islands between Japan and Taiwan or it may be topographically and structurally fused with the inner arc, e.g., Japan.

Troughs are simply depressions in the deep sea floor of which Barleltt trough is the most important example.

Marginal sea basins lie between the island arcs and the continents, e.g., the Philippine Sea. These basins are 500-1000 km wide and may include abyssal plains extending down to more than 5 km below sea level.

The Plateaus

Plateaus are submarine elevations of considerable extent with relatively flat tops. Examples of plateaus are the Albatros plateau in the Pacific Ocean off south and central America, the Seychelles plateau of the Indian Ocean and the Azores plateau in the north Atlantic Ocean.

Continental and Oceanic Crust

Thickness

1. Continental crust ranges in thickness from 30-50 km. Oceanic crust is 10-20 km thick.

Age

2. Continental crust contains the oldest rocks on the Earth, which ranges in age up to 3.8 b.y. Oceanic crust is less than 200 m.y. old.

Rock type

3. Continental crust is basically granitic in composition and also contains andesitic lavas, ashes, intrusive granites along with some basalt. Oceanic crust is composed largely of basalt and to some extent gabbro.
4. Continental crust contains a wide range of limestones, sandstones, shales and conglomerates. Oceanic crust contains calcareous and siliceous oozes, red clay and flash association.
5. Continental crust consists of a wide range of metamorphic rocks—gneiss, schist, slate, marble and metamorphic rocks compositionally similar to granite.

Oceanic crust does not contain any metamorphic rock.

Deformation

6. Continental crust has been extremely deformed. The oceanic crust has not been deformed.

Processes

7. The internal energy sources on continents give rise to marginal volcanic activity, deep burial of rocks, metamorphism and granitisation. Internal energy sources result in the creation of ocean floor as well as subduction of the ocean floor.
8. External energy sources manifest themselves in subaerial weathering, erosion, transport, deposition by running water, ice, wind, and waves along the coasts of continents. External energy sources manifest themselves in waves, tides and currents in the oceans.

Relief

9. Continental positive relief features include fold mountains, uplifted plateau and volcanoes; plains include platform areas, low-lying shield, continental shelves and coastal plains. Oceanic positive relief features include ocean ridges, volcanoes and plains including abyssal plains.
10. Continental negative relief features include rift valleys, eroded valleys by streams and glaciers, and deflation hollows. Oceanic negative relief features include ocean trenches and submarine canyons.

Origin of Crust

In the beginning, the surface of the Earth was very much like that of Mercury, Venus and other planetary bodies. The Earth's entire surface was littered with craters and the temperature was also very high. There were no continents or ocean basins, no land or sea, and no life. It was only at the end of the Precambrian that the planet actually had continents, ocean basins and life. The precise way in which this evolution took place is not known and several questions have to be answered in the context of the origin and evolution of the Earth's crust. These questions are:

1. What was the extent of the first crust, was it local or of worldwide scale?
2. What were the processes responsible for the growth of the crust and at what rate did the early crust grow?
3. What was the composition of the early crust?
4. When and how did the crust got separated into continental and oceanic crust?

The oldest rocks of the Earth's crust collected from Greenland, Australia and South Africa are continental rocks roughly 3.8 b.y. old. These are not a part of the primitive crust but possess an advanced continental composition. Most of these rocks are metamorphosed sedimentary rock. This means that :

(i) the oceans had already formed by this time and

(ii) sediments demonstrate that some high standing continental platforms evolved very early in the Earth's history.

The mineralogy and chemistry of some of these Archean metamorphic rocks show that they crystallised at about 550 to 8000° C at 5 to 8 kilobars at depths of 2.7 km. These rocks were also underlain by an additional 35 km of crust. Thus, some type of continental crust 50-70 km thick existed on the Earth by 3.8 b.y. ago. It is presumed that the earliest terrestrial crust may have formed between 4.2 to 4.5 b.y. and since then it has been partially recycled and the first stable crust did not form until about 4 b.y. ago.

The extent of the first crust may be determined by comparison with the lunar crust and crust of other terrestrial planets. For example, the lunar highlands appear to represent the remnants of the early lunar crust (4.5 to 4.3 b.y. old) which covered almost the entire lunar surface. On Mercury and Mars, the widespread primitive crust has been preserved. If the history of the Earth is similar to these planets, which of course it is, then it is very likely that the Earth also had an early crust that covered its surface.

The origin of the crust can be explained in terms of three groups of theories:

1. Inhomogenous Earth accretion model.
2. Catastrophic model.
3. Non-catastrophic model.

Inhomogenous Model of Earth's Accretion : This model assumes that there was a hot solar nebula. The temperature in the nebula was constantly falling. With the fall in temperature, the various compounds of the solar nebula condensed and gathered, i.e., solid particles collided to form planetary bodies in the disc around the Sun. This progressive condensation and accretion resulted in planetary growth. The zoned structure of the Earth with an iron core surrounded by a silicate mantle, may have been produced by sequential condensation and accretion of the Earth from the cooling solar nebula.

The last compounds to condense produced a thin layer of planetary surface, rich in alkaline and other volatile elements, which formed the first crust. However, if the crust evolved in this manner, i.e., by inhomogenous accretion, the non-volatile elements like uranium, thorium and Rare Earth Elements (REE) should have been concentrated in the core and lower mantle. Instead, they are concentrated in the crust. This concentration may have been the result of magmatic transfer from within the

Earth, producing a crust of magmatic origin and concentrated REE in the crust.

Surface Impact

The Earth has been subjected to extensive severe bombardment. The tremendous energy given off during large impacts may have produced a localised melting within the Earth and the magmas derived from these meltings may have solidified to form the first crust. When large bodies hit the Earth's surface, craters were formed and energy was transferred to the Earth. These craters were approximately 10 km deep and there was a sudden drop in pressure.

This sudden release of pressure together with the production of a series of radiating fractures resulted in partial melting of the mantle beneath the crater. Erosion of the crater rim, and intrusion and extrusion of dominantly mafic magma from underneath filled the crater. Fractional crystallisation of mafic magmas produced granitic magma, which were intruded at shallow depths.

The crater, which was filled by sediments and igneous rocks, rose isostatically to form a protocontinent. The impact of collision may also have initiated a convection cell beneath the protocontinent, thus, thickening the crust and causing it to grow by peripheral magmatic accretion. Such a collision may also have initiated the formation of a mantle plume, which rose and provided a possibility for the future growth of continental nuclei.

Perhaps the Archean continental nuclei were produced over rising mantle plumes that were triggered by the impact on the Earth's surface. Following this analogy that impact necessarily leads to generation of magma, significant amount of magma should have been produced on the Moon. This is, however, not the case.

Processes of Deformation

The crust of the earth is only about 60 km (36 miles) in thickness. It is, however, continuously affected by the crustal formation and deformation processes. The earth's continental crust is formed and deformed by the tectonic activity, driven by our planet's internal energy.

Crustal Formation Process

Tectonic activity produces continental crust that is quite varied. Nevertheless, continental crust generally can be thought of in three categories:

1. Residual mountains and continental cores ('shields') that are inactive remnants of ancient tectonic activity.
2. Tectonic mountains and land forms, produced by active folding and faulting movements that deform the crust.
3. Volcanic features, formed by the surface accumulation of molten rock from eruptions of subsurface materials.

Thus, several processes operate in concert to produce the continental crust.

Continental Shields

Generally old, low elevation heartland regions of continental crust are known as *continental shields.* These are the nucleus of crystalline rock on which the continent 'grows' with additions of other crust and sediments. The nucleus is the creton, or heartland-region, of the continental crust. Cretons generally have been eroded to a low elevation and relief and are old (most exceed two billion years in age, but all are Precambrian, or older than 570 million years). Portions of creton are covered with layers of sedimentary rocks that are quite stable over time. An example of such a platform is the region that stretches from the Rockies to the Appalachians and northward into central Canada. The Baltic Shield, Angara Shield, Australian

Shield, African Shield, Brazilian Shield and Guianan Shield are the other such examples. A region where a creton is exposed at the surface is called a *continental shield.*

The Construction

Continental crust results from a complex process that involves seafloor spreading and formation of oceanic crust, its subduction, remelting, and subsequent rise of magma. To understand this process, begin with the magma that originates in the asthenosphere and wells up along the mid-ocean ridges. It is less than 50 percent silica and is rich in iron and magnesium. This material rises at the spreading centres, cools to form ocean floor, spreads outward, and collides with continental crust. Being denser the oceanic crust plunges back into the mantle, and remelts. This magma then rises and cools, forming more continent.

Bodies of silica-rich magma may reach the surface in explosive volcanic eruptions, or they may stop short and become subsurface intrusive bodies in the crust, cooling slowly to form crystalline plutons such as batholiths.

Terranes : The migrating crustal pieces, dragged about by processes of mantle convection and plate tectonics are known as *terranes.* Displaced terranes are distinct in their history, composition, and structure from the continents that accept them. 'Terranes' should not be confused with '*terrain*' which refers to the topography of a tract of land.

The Applachian mountains, extending from Alabama to the Maritime provinces of Canada, possess bits of land once attached to ancient portions of Europe, Africa, South America, Antarctica and various oceanic islands. These discoveries, barely a decade old, demonstrate how continents are assembled.

Processes of Deformation

Rocks, whether they are igneous, sedimentary or metamorphic, can be subjected to powerful stress by tectonic forces, gravity and weight of overlying rocks. There are three types of stress:

1. Compression (shortening).
2. Tension (stretching).
3. Shearing (stress when two pieces slide past each other).

The strain that results from these stresses (how the rocks respond) is expressed as *folding* (bending) or *faulting* (breaking).

Rock Bending

A flexure or bending of the rocks of the earth's crust owing to compressional forces is known as *folding.* If the flexure takes the form of an arch, the fold is termed an *anticline* (more generally an *antiform),* while a flexure in the form of a trough is a *syncline* (more generally *synform).*

The line along which a change in the amount and/or direction of dip takes place is known as the *hinge line,* and on many folds this coincides with the position of maximum curvature. The area adjacent to the hinge line is known as the *hinge area* or nose of the fold. The limb of a fold is the part which lies between one hinge and the next, and the angle between the limbs is called the *inter-limb angle*.

A fold is said to close in the direction in which the limbs converge. As seen on a map, one says that a fold "closes to the north-west etc." As seen in a vertical section, a fold may be said to close upwards (antiform) or downwards (synform). For an antiformal fold the direction of closure is the direction of plunge. A plane which joins the hinge lines of the successive beds in a fold is the axial plane. Fold axis is a term which has been used by different authors with different meanings, but from a practical point of view the best definition appears to be that it is a line parallel to the hinge. This may be expressed alternatively as the trace of the intersection of the axial plane on any bed constituting the fold.

It should be noted that the trace of the axial plane on the ground surface coincides with the axis only for folds of certain specific attitude. A *crest line* marks the highest points on the same bed in an antiformal fold, whereas a *trough line* marks the lowest points on the same bed in a formal fold. The crestal plane and trough plane are the planes connecting the crest lines and trough lines respectively of the successive beds of a fold. Axial planes, crestal planes and trough planes are not always flat, and may be curved in various ways, and also the axial plane of a fold is not necessarily coincident with the crestal plane.

Important Types

The type, shape and size of the folds depend upon the intensity and direction of the compressive forces and upon the nature of the rocks of the different strata of the sedimentary rocks. On the basis of shape and size, folds have been classified under the following categories: (i) symmetrical, (ii) asymmetrical, (iii) one limb-vertical, (iv) isoclinal, (v) recumbent, and (vi) anticlinal.

Symmetrical Fold (Simple, Upright or Open Fold) : If the axial plane bisects the fold, the fold is said to be symmetrical or simple or open fold. In other words, where the compression is relatively mild or more or less equal from both sides, the folds are simple, open, upright or symmetrical. Simple or symmetrical folds are, however, rare.

The Jura mountains of France and Switzerland are a typical example of symmetrical or simple folds. The Jura folds lie just to the north of the main collision orogen of the Alps and are therefore called as *foreland folds.* The Zagros mountains of south-west Iran are another example of foreland folds.

Asymmetrical Fold : If the axial plane has a dip, the fold is described as inclined or asymmetrical fold. The asymmetrical folds are characterised by unequal and irregular limbs. In asymmetrical folds, both the limbs are inclined at different angles. One limb is relatively larger and the inclination is moderate, while the other limb is relatively shorter with steep inclination and length.

One Limb-Vertical Fold : When the axial plane is inclined in such a way that one limb is vertical and the other steadily inclined, such a fold is called as one limb-vertical fold.

Isoclinal Fold : If the two limbs of a fold are parallel, the fold is said to be isoclinal. Isoclinal folds are formed when the compressive force is so strong that both the limbs of the fold become parallel but not horizontal.

Recumbent Fold : This is an overturned fold in which the axial plane is virtually horizontal.

Anticlinal Fold : An arched fold or upfold in the strata of the earth's crust. The two sides or limbs of the fold dip in opposite directions away from a crest-line or central axis. If the dip of each limb is equal, it is a symmetric anticline; if the angle of dip of one limb is greater than the other the anticline will be asymmetric (asymmetric fold) or overfolded. Because denudation generally attacks the arches of folded structures faster than it does the downfolds (syncline), it is common for these to become the location of valleys which run along the anticlinal axis, thereby exposing older rocks in the core of the anticline. In some areas, a complex anticline of great lateral extent is found in which many minor folds occur. Such a feature is known as *anticlinorium*.

Syncline : A syncline is a downwarped fold—just the reverse of an anticline. The sides of a syncline dip toward each other, meeting at the bottom of the fold. If synclines are closed due to the downward plunge on all sides of the rocks that make up the structure, the resulting form is basin or canoe-shaped. The sizes vary as greatly as in case of anticlines (synclines occur very commonly besides anticlines).

A complex syncline of great lateral extent in which many minor folds occur is known as *synclinorium.* Contrary to this, a series of smaller anticlines and synclines which form part of a larger arched structure in the earth's crust is known as anticlinorium.

Nappe : Nappe is a fold in which the axial plane is horizontal or sub-horizontal. It is a large scale tectonic over fold in the earth's crustal rocks, which has moved forward as a recumbent fold sometimes for tens of kilometres along a thrust plane (thrust-fault), thereby detaching itself from the so-called zone of roots. Nappes were first described in the Alps. A few examples of nappes have also been traced in the Himalayas. These nappes are in the Kashmir Himalaya (Wadia), Shimla Himalaya (Pilgrim), Garhwal Himalaya (Auden), and Kumaun Himalaya (Heim and Gansser).

The Faults

Faults are fractures in earth's crust along which slippage or displacement has occurred. A fracture in rock along which there has been an observable amount of displacement. In other words, fault is a rupture or fracture of rock strata due to strain, in which displacement is observable. Most faults occur in groupings, termed as *fault zone* or *fracture zone.* Thus fault zones are areas of crustal movement. At the moment of fracture the fault line shifts and a sharp release of energy occurs, called an earthquake or quake.

Faulting is accompanied by a displacement—a slipping motion—along the plane of breakage, or *fault plane.* Faults are often of great horizontal extent, so that the surface trace, or *fault line,* can sometimes be followed along the ground for many kilometres. Most major faults extend down into the crust for at least several kilometres.

Faulting occurs in sudden slippage movements that generate earthquakes. A single fault movement may result in slippage of as little as a centimetre or as much as 15 metres (about 50 feet). Successive movements may occur many years or decades apart, even several centuries apart. Over long time span, the accumulated displacement can amount to tens or hundreds of kilometres.

The following are the main nomenclatures of a fault:

Fault Plane : The plane along which the rocks are displaced by tensional and compressional forces acting vertically and horizontally is known as a *fault plane.* A fault plane may be vertical, horizontal, inclined, curved or any other form.

Fault Dip : The angle which the fault plane makes with the vertical plane is known as *fault dip.* In other words, it is the angle between the fault plane and horizontal plane.

Fault Strike : The term 'strike' is applied to a fault plane in precisely the same way as to bedding plane.

Upthrow Side : The uppermost block of a fault is known as upthrow side.

Downthrow Side : The lowermost block of a fault is known as *downthrow side*.

Hanging Wall : The upper wall of a fault is known as *hanging wall*.

Foot Wall : The lower wall of a fault is known as a *foot wall*.

Fault Scarp : A cliff formed directly by the displacement of a recent fault, but usually on a small scale (10 m in height). It is a relatively transient land form since denudation will soon modify the scarp, turning it into a fault line scarp or obliterating it altogether.

Several types of faults have been recognised by the geologists and geomorphologists. Some of the important faults are described as under:

Normal Fault (Tension Fault) : The faults having primarily vertical movement are called *normal faults.* A normal fault occurs when rocks are pulled apart. The plane of slippage or the fault plane is steep (usually between 65 and 90 degrees), or nearly vertical. A normal fault results in a steep, straight, cliff-like feature called *fault scarp.* Fault scarp range in height from a few metres to a few hundred metres. Their length is usually measurable in kilometres. In some cases they attain lengths as great as over 300 km (about 200 miles). A narrow block dropped down between two normal faults is a *graben.* A narrow block elevated between two normal faults is a *horst.* Grabens make conspicuous topographic trenches, with straight, parallel walls, while horsts make block-like plateaus or mountains, often with a flat top but steep, straight sides.

Reverse Fault (Thrust Fault) : *A reverse fault* is one in which the hanging wall is on the upthrow side. This is also called a *thrust fault.* On account of extreme compression rocks snap, and one stratum is pushed over the underlying stratum, i.e., the upper side is displaced above the fault plane relative to the side below. There is thus shortening of the crust in reverse or thrust fault as a result of compressional forces.

Lateral or Strike-Slip Fault (Tear Fault) : A *strike-slip fault* is formed when the rock blocks are displaced horizontally along the fault plane due to horizontal movement. The best known of the strike-slip faults is the Great San Andreas fault of California, nearly 1,200 km long. Strike-slip faults result from shear stresses in the crust. They are commonly produced where one tectonic plate slides past another at a transform fault boundary. They also form as 'accommodation' faults, when two segments of the crust are stretched or shortened at different rates.

Step Fault : A normal fault which, when repeated by a series of parallel faults each with an increased throw in the same direction, will produce a stepped slope. Step faults are common in a fault-block topography and may be present on the flanks of a rift valley.

Hinge Fault : A hinge fault forms where the displacement increases from zero to a maximum along the strike.

Rift Valley : A linear depression or trough created by the sinking of the intermediate crustal rocks between two or more parallel faults is known as a 'graben' and the accompanying morphological feature as a *rift valley*. The East African Rift Valley, and the Rhine-Graben are some of the typical examples of these features. The Rift Valley of East Africa Rifting of continental lithosphere is the very first stage in the splitting apart of continent to form a new ocean basin. The process is beautifully illustrated by the East African Rift Valley System. This region has attracted the attention of geologists since the 1900s. They gave the name *rift valley* to what is basically a *graben*, but with a more complex history that includes the building of volcanoes on the graben floor.

The East African Rift Valley System extends from the Red Sea southward about 3,000 km (about 1,800 miles). Along this axis, the earth's crust is being lifted and spread apart in a long, ridge-like swell. The rift valley system consists of a number of graben-like troughs, each in a separate rift valley ranging in width from about 30 to 60 km (20 to 40 miles). Major rivers and several long, deep lakes, for example, Lake Nyasa and Lake Rudolph, occupy some of the valley floors. Two great volcanoes have been built close to the rift valley east of Lake Victoria. One is the Mount Kilimanjaro, whose summit rises to over 5,895 m (about 19,160 ft.). The other, Mount Kenya, is only a little lower and lies on the equator.

Importance of Faults

Faults have great geomorphological, ecological and socio-economic significance. They are the producers of earthquakes, and pulverisers of the rocks. From the economic point of view, petroleum deposits are found in porous sedimentary rocks that have been faulted against impervious shale beds. Consequently, areas of faulted sedimentary strata are favourite areas of oil exploration. Faults also give rise to the underground water table along fault planes which result into springs (hot and cold). In fact, most of the hot and cold springs are situated along fault lines. Moreover, fault scarps can form topographic barriers across which it is difficult to build roads and railways. They may also give rise to waterfalls.

Faults also have tremendous importance in the weathering of rocks. The courses of small streams often follow joint systems. While stream erosion, particularly on the outer bends of meandering rivers, is made more rapid and effective by joints. Glaciers and waves would be much less effective erosive agents, if they worked on perfectly solid rather than jointed rocks.

Isostasy of Theory

The state of balance which the earth's crust tends to maintain is known as *isostasy*. The word 'isostasy' has been derived from the Greek language. The gravitational adjustment of earth's crust is isostasy (Greek *isos,* 'equal'; *stasis,* 'standing'), a state of balance, i.e., if anything occurs to modify the existing state, a compensating change will occur to maintain a balance. The concept of isostasy is based on the principle of buoyancy, first outlined by Archimedes. Buoynacy is the ability of an object to float in a fluid by displacing a volume of that fluid equal in mass to the floating object's own mass. A steel ship floats because its shape displaces a volume of water equal in weight to its own weight plus the weight of its cargo. Thus, an empty containership displaces a smaller volume of water than the same ship when fully loaded. The water supporting the ship is not 'strong' in the mechanical sense, water does not support a ship in the same way a strong steel bridge supports the weight of your car. Buoyancy rather than mechanical strength, supports the ship and her cargo.

Any region of a continent that projects above sea level is supported in the same way. As an extreme example, consider the continent containing Mount Everest—the highest of the earth's mountains at 8.84 km (29,008 feet) above sea level. Mount Everest and its neighbouring peaks are not supported by the mechanical strength of materials within the earth, nothing on (or in) our world is that strong. The mountainous upper surface of the continent floats high above sea level because the lithosphere of which it is part sinks into the plastic asthenosphere until it has displaced a volume of asthenosphere equal in mass to its own mass. The continent's mountains rest at great height, in balance with their subterranean underpinnings but susceptible to rising or falling as erosion or crustal stresses dictate. Lower regions are supported by shallower roots. Like a ship floating in water, the entire continent stands in isostatic equilibrium.

It is best illustrated by a high mountain chain which rises above the surface of the earth but has to be compensated by deep 'roots' of sialic *(sial)* material which penetrates deeply into the underlying *sima.* Isostasy occurs because the crust is buoyed by the more dense mantle beneath it, and each portion of the crust displaces the mantle according to its thickness and density. Denser crustal material sinks deeper into the mantle than less dense crustal material. Alternatively, thicker crustal material will extend to greater depth. Isostatic adjustment in earth's crust can be compared to adjustments in a sheet of ice floating on a lake as you skate on it. The layer of ice bends down beneath you, displacing a volume of water with a weight equal to your weight. As you move ahead, the ice rebounds behind you, and the displaced water flows back.

As a result of isostatic adjustments, high mountains and plateaus having a great vertical thickness sink deeper into the mantle than do areas of low elevation. Any thickness change in an area of the crust, such as the removal of material by erosion or the addition of material by sedimentation, volcanic extrusion, or accumulation of large continental glaciers, causes an isostatic adjustment.

Geologists' Approach

The concept of isostasy, therefore, is fundamental to studies of the crust's major features— continents, ocean basins, and mountain ranges—and to understanding the response of crust to erosion, sedimentation, glaciation, and tectonic system.

Continental glaciers are a clear example of isostatic adjustment of the crust. The weight of an ice sheet several thousand metres thick disrupts the crustal balance and depresses the crust beneath. In both Antarctica and Greenland, the weight of the ice has depressed the central part of the land masses below sea level. Antarctica provides an excellent example of how continents maintain isostatic equilibrium in the face of changing conditions. Most of the southern continent is covered by a layer of ice as much as 4 km (13,000 feet) thick. The great weight of the ice has pushed much of the continental crust below sea level. If this ice were to melt, Antarctica would slowly rise from the water much the same way a ship rises while being unloaded. A similar isostatic adjustment occurred in Europe and North America during the last ice age, when continental glaciers existed there. Parts of both continents, such as Hudson Bay and the Baltic Sea, are still below sea level. Now that the ice is gone, however, the crust is rebounding at a rate of 5-10 metres per 1,000 years.

The construction of Bhakra dam is another example of isostatic adjustment because the added weight of water and sediment in the Gobind Sagar (reservoir) was sufficient to cause measurable subsidence. From the time of the construction of the dam in 1956 enormous quantity of water, plus an unknown quantity of sediment, accumulated in Gobind Sagar, behind the dam. Within a few years, this added weight caused the crust to subside around the lake.

In brief, the concept of isostasy depends upon the model of the earth's crust in which lighter, continental masses 'float' on a denser substratum. In the words of Steers (1961), the doctrine of isostasy states that whenever equilibrium exists on the earth's surface, equal mass must underlie equal surface areas.

The concept of isostasy has been conceived differently by the different geologists. The views of a few of them are discussed in the following paras.

Airy's Views : Sir George B. Airy (1801-92)—the Astronomer Royal in 1851—opined that the continents which are made of lighter material *sial* are floating over the substratum which is made of denser material *sima.* The suggestion was put forward to account for certain serious features concerning the gravitative attraction of the Himalayas. During the Trigonometrical and Geodetic Survey of India the difference of latitude between two stations, Kalianpur and Kaliana, was obtained both by direct triangulation and by astronomical methods. The difference in the latitude obtained by the two means amounted to 5.236. It is important to note that Kaliana, the northern of the two stations, is only about 100 km (60 miles) from the Himalayas. He opined that the lighter sial of the Himalayas is floating over the denser material of the sima lying underneath. He also made it vividly clear that the Himalayas were not just surface feature but that the light rocks of the mountain extended as roots deep down into the denser rocks below. Just as a large part of the boat remains immersed in water to keep it afloat, so are the Himalayas floating on the denser rocks below and the weight of the mountains is balanced by light materials penetrating into considerable depths.

In fact, the principle of isostasy is really nothing else than that of ordinary floatation, and the example of an iceberg floating in water may help stress the fundamental concept of the doctrine. Ice floats in water in such a way that, approximately, for every one part above water level there are nine parts below. That is to say, the ratio of free board to draught is 1 to 9. On this analogy, if we assume the average density of the continental rocks to be 2.67 and that of the substratum as 3, as suggested by Joly, then nearly eight times the height of the rocks above the substratum should penetrate into the denser substratum. In other words, the density of the rocks must be relatively low down to considerable depths below these mountains. The important point, however, is that they are compensated as a whole, and the individual peaks and valley are not separately compensated. To take a somewhat farfetched example, it would be quite wrong to assume that, if Mount Everest is about 30,000 feet high, and if the ratio assumed of draught to free board is correct, then there is a downward projection of lighter material beneath that mountain reaching to about 2,40,000 feet. By stating of mountain areas being compensated, it is implied that the mountains are regarded as a great plateau whose height is equal to that of the mean height of the mountain chain. The same reasoning must also apply to the continents. Joly estimates their mean heights and concludes that the continental material is about 31 km thick on an average.

Airy established his point with the help of an illustration of wooden blocks of different heights floating in water with each block moving vertically and independently of its neighbour. All blocks are of equal density but different heights, and they float, the longest blocks extending deepest into the mantle. At a certain depth, equal to or greater than the thickest crust, the pressure is everywhere constant and below it the mantle is in a state of hydrostatic equilibrium. The blocks emerge by amounts which are proportional to their heights, so that the block which rises highest above the water is also the block which goes deepest into the water. These blocks are said to be in a state of hydrostatic balance or equilibrium. Similarly, the land masses are composed of similar density of rocks, but they penetrate deep into the substratum in proportion to their height. Thus, Airy assumed that the continents and islands are resting, or rather floating, in denser mass, and that excess of matter above the upper surface of the substratum is balanced by deep projection of the lighter material into the substratum. In short, the sial masses are in hydrostatic equilibrium. The fundamental concept of Airy, i.e., the continental masses floating as lighter *(sial)* blocks in a heavier *(sima)* substratum, has been rejuvenated by Heiskanen's work, so that it is now probably true to say that most geologists favour Airy's explanation.

Pratt's Views : The data obtained from the trigonometrical and geodetic survey of Kalianpur and Kaliana in Indian plains were computed by J.H. Pratt. According to Pratt, the gravitational attraction of the Himalayas was less than the mass represented by these mountains because the mountains were made of much lighter materials, i.e., rocks of much lower density. He stipulated that the rocks of the mountain chains should have a lower density than those of the plateaus, the rocks of the plateaus lower than the plains and the plains lower than the rocks of the ocean floor. In his opinion, there was an inverse relationship between height and density—higher the column lesser the density, and smaller the column greater the density. Pratt visualised that there was a level above which these density changes were found and below that level the density was uniform. In other words, the density of a particular column was the same from top to bottom but the density of different columns were different.

Pratt's concept of isostasy was related to 'the law of compensation' and not to 'the law of floatation'. According to Pratt, different relief features are standing only because of the fact that their respective mass is equal along the line of compensation because of their varying densities. It may be seen from the figure that columns of lead, iron, antimony and zinc, having different densities, are placed in a jar, filled with mercury. The heights above the mercury level of the floating columns is different but inside the mercury they are at a uniform depth. He, however, does not believe in the 'root formation'. Thus, the fundamental difference between Airy's and Pratt's views is that the former postulated a uniform density with varying thickness, while the latter a uniform depth with varying density.

Views of Hay ford and Bowie : The views expressed by Hayford and Bowie about isostasy were in agreement with that of Pratt. According to them, there is a plane where there is a complete compensation of the crustal parts. Densities vary with elevations of columns of crustal parts above this plane of compensation. Thus, the density of the mountains is less than the ocean floor. In other words, the earth's crust is composed of lighter material under the mountains than under the floor of the oceans. According to Hayford and Bowie, there is an inverse relationship between the height of columns of the earth's crust and their respective densities above the line of compensation. The plane or level of compensation is supposedly located at the depth of about 100 km. The columns having the rocks of lesser density stand higher than the columns having the rocks of higher density.

Joly's Views : The views advocated by Hayford and Bowie were criticised by Joly. His main objection was about the depth of compensation (100 km). In his opinion, the temperatures would be so high that all rocks would melt and become liquid at such a depth. According to Joly, there is a 16 km (10 miles) thick layer below the areas having similar low density. The areas of low density penetrate into this thick layer, while where the surface rocks are of higher density, the heavier materials below rise to higher levels. Joly, thus, conceived the level of compensation not as a straight line surface but as a zone of compensation. This view is much closer to the floatation theory of Airy. In the opinion of Joly, the earth's crust consists of lighter materials *(siat)* whose average density is 2.67. Below this is the *sima* whose density is 3. The sial is floating over the sima like an iceberg. Thus, these views are in conformity with the model of the earth's crust in which the lighter continental masses 'float' on a denser substratum.

Holmes' Views : The views of Arthur Holmes were also similar to that of Airy. Holmes was of the opinion that the higher relief features of the earth's surface are composed of lighter materials and their portions lie buried in the heavier and denser rocks below to keep them in a state of hydrostatic balance. He further opined that mountain ranges have roots largely composed of sialic rocks, going down to depths of 50 to 60 km. In coastal plains the thickness of the sial and other crustal rocks is only 30 km or less and beneath large parts of the deep ocean floor, the sial is either extremely thin or totally absent. According to Holmes, the lighter columns are standing because of the fact that there is lighter material below them for greater depth whereas there is lighter material below the smaller columns upto lesser depth.

Adjustment of Isostasy

A perfect isostatis adjustment is possible only theoretically.

In fact, the earth is unstable and unresting as the endogenetic and exogenetic forces continuously disturb the isostatic adjustment. In fact, the endogenetic forces and the resultant tectonic events cause disturbances in the ideal condition of isostasy but the nature always tends towards the isostatic adjustment, if not at the local, at the regional level. For example, a newly formed mountain due to tectonic activities is subjected to severe denudation. Consequently, there is continuous lowering of the height of the mountain. On the other hand, eroded sediments are deposited in the oceanic areas, with the result there is continuous increase of weight of sediments on the sea floor. Due to this mechanism, the mountainous area gradually becomes lighter and the oceanic floor becomes heavier, and thus the state of balance or isostasy between these two areas gets disturbed but the balance has to be maintained.

In brief, when an uplifted land mass or mountain is worn down by the agents of erosion, the load on the underlying column of the crust is reduced by the weight of the material that has been eroded away. At the same time, a neighbouring column underlying a region of delta and sea floor where the denuded material is being deposited, receives a corresponding increase of load. At the base of the crust the pressure exerted by the unloaded column is increased. In response to this pressure difference in the mantle there is a subcrustal slow flow of sima from under the loaded column towards the base of the unloaded column.

The loaded column, therefore, sinks, while the unloaded column rises. This process, whereby isostatic equilibrium is resorted, is called *isostatic adjustment*. This is made possible by a compensating transfer of material in the sub-crust. For example, extensive parts of North America and Eurasia were subsided under the enormous weight of accumulation of thick ice sheets during Pleistocene glaciation, but the land masses began to rise suddenly because of release of pressure of superincumbent thick load of ice sheets due to deglaciation and consequent melting of ice sheets about 25,000 years ago, and thus the isostatic balance was disturbed.

The raised beaches of Finland and Scandinavia show that an uplift of about 250 metres has already taken place during the last 8,000 years and the region is still out of isostatic balance and is rising. The theories discussed above and the given examples illustrate several important facts about gravity and isostatic adjustments:

1. Gravity is the driving force for all isostatic adjustments. All types of loading and unloading, therefore, cause vertical movements. Isostasy is involved in all of the processes that shift material on earth's surface. Some of the more obvious isostatic adjustments to be expected are as follows:
   (a) In mountains and highlands, as erosion removes material, the crust should rebound.
   (b) In deltaic areas, where sediment is deposited, the added weight should cause the crust tosubside.
   (c) In areas of volcanic activity, the added weight of excursions should cause the crust tosubside.
   (d) In regions of continental glaciation, the thick ice sheet should cause the crust to subside. As the ice is removed, the crust should rebound.
2. Very small loads, such as water a few hundred metres deep, are also sufficient to cause isostatic adjustments.
3. Isostatic adjustments can occur very rapidly in a geological time frame (60 metres in fewer than 20,000 years).

6

Structure of Earth

Internal Structure of Earth

A study of the interior of the Earth is necessary to understand many of the fundamental mechanisms underlying the Earth's dynamic surface. The surface of the Earth is readily sampled and analysed and therefore, there is a good deal of information about it.

However, the factual evidence concerning the interior of the Earth is not readily available. Geological process can expose rocks created at some 20-25 km depth and volcanoes erupt pieces of rock that were once part of the Earth's upper mantle. The deepest hole in the Earth—a drill hole is only about 8 km deep and there is no method of sampling at greater depth.

Apart from these data there is no direct evidence concerning the interior of the Earth. For these reasons, ideas on the interior of the Earth are based on indirect evidences and are therefore somewhat speculative.

Interior Probing

The study of the Earth's interior can be approached in two ways :

A. By considering the Earth as part of the solar system and deducing indirectly such factors as its speed of rotation, density and mass (all of which fall within the domain of astronomy).

B. By analysing direct information, particularly that provided by seismic waves produced by natural or artificial earthquakes, and by the measurement of gravity.

Interior Density

Density is defined as the mass per unit volume and is usually expressed in grams per cubic centimeter written as g/cm^3. If the earth is considered to be spherical in shape, then using the known value of the Earth's radius and mass, its density can be determined. The average density of the Earth is thus calculated to be 5.52 g/cm^3. This calculated density is considerably greater than the average density of the earth s crust (2.8 g/cm^3). In order that the average of the earth's density has such a high value, the material below the crust must have a density much greater than that of the crust. Since the Earth wobbles only very slightly as it rotates and since the acceleration due to gravity over the Earth's surface is quite uniform, the earth's mass must be distributed uniformly about the Earth's centre as in a series of concentric layers. A study of density, gravity and the Earth's dimension makes it possible to calculate the pressures within the Earth and also the temperatures that can be reached under this pressure.

The Meteorites : Meteorites are considered to be the remnants of unknown planets. Some meteorites are made of stony silicate or rocky lumps, some composed mainly of iron, nickel and other metals, a few are stony iron with metal inclusions. Meteorites allow us to directly analyse the density, chemistry and mineralogy of the nickel iron cores of bodies having a similar composition to that of the Earth.

The Seismic Studies : Seismic study involves the study of the seismic waves. Seismic waves are vibrations usually created by disturbances within the earth's crust. These disturbances may be due to slippages along an earthquake fault or an underground nuclear explosion. Seismic waves travel through the Earth and are detected at seismograph stations on the Earth's surface. A seismic activity generates two types of waves— (a) body waves and (b) surface waves.

The body waves are of two types:

(i) *P Waves or Primary Waves or Compressional Waves :* In these waves the individual particles of the material, in which the waves are travelling, oscillate back and forth in the direction of propagation.

(ii) *S Waves or Secondary Waves or Transverse or Shear Waves:* In these waves the oscillations occur transverse to the direction of propagation.

Surface waves are confined to the surface of the earth. They are of two types Love waves and Rayleigh Waves.

A wave is the propagation of strain through a material. If any small volume within an elastic medium is distorted or strained in some way, a stress is developed, which tends to restore the material to its original undisturbed state. The ratio of stress to strain is the elastic modulus of the material. Because a material can be strained in different ways so it has more than one wave velocity. The general expression for the wave velocity of two seismic waves are :

$$Vp = V(K+4u/3/d)$$

$$Vs = Vu7d$$ where,

k = bulk modulus (a measure of the stress needed to compress the material to a smaller volume)

p = rigidity modulus (a measure of the stress needed to change the shape of the material)

sd = density

P waves both compress and change the shape of the material and hence depend on density and compressibility of the material. S waves depend on density and rigidity of the material and therefore cannot propagate through a liquid, which cannot resist change in shape and hence has no rigidity.

Seismic waves have two properties, which make them particularly useful in revealing the Earth's internal structure.

(1) Earthquake waves are reflected when they strike the interface between two different materials having different elastic properties and density. This reflection is in accordance with Snell's law.

(2) Seismic waves tend to bend or refract to when they enter a medium in which they travel at a slower speed. This is not a unique property of seismic waves rather, it is shared by all waves.

When a wave strikes an interface between two materials, the amount by which it is bent depends on the difference in wave velocities between the two materials. The greater the change in speed, the greater will be the refraction of the waves. When the wave speed changes gradually within a material the wave will also bend gradually. The more gradual the change in wave speed the more gradually the wave will bend. Consequently, when a seismic wave crosses an interface between two distinct regions the change will be abrupt and when it passes through regions where there are gradual changes in pressure, temperature or composition the waves will bend gradually.

These seismic waves can be detected at various other points on the surface. The time required for the wave to arrive at any detector depends on the path of the wave through the Earth and on the speed of the wave along that path and the two are related.

Since the path followed by the wave depends on the distribution of wave speeds within the Earth, therefore from an analysis of arrival times for seismic waves at various points along the Earth's surface we can use the known relationship between wave speeds and paths to discover exactly how the speed of seismic waves varies with depth inside the Earth. If the wave speed is known at any given depth, this can provide physical parameters such as density, rigidity and compressibility for the various layers within the major structural units of the Earth.

The paths taken by the seismic waves (body waves) as they pass through the Earth provide information about the dimensions, structure and physical properties of each of the internal layers. If the interior of the Earth had uniform properties (it was an isotropic medium) the waves would follow straight lines and their speed would not change but when they pass through an anisotropic medium they follow a curved path. The earthquake waves are reflected and refracted when they come to boundaries of different elastic properties or densities (discontinuity) and follow a curved path with change in velocity. These discontinuities are due to changes in composition, atomic structure or atomic state and occur at several places within the Earth.

As a single medium cannot transmit waves of the same type (P or S) at different speeds, when two compression waves are received separately at a station, the implication is that they must have been propagated in different media (wave channels). The discovery of these channels and their transitional zone is an important seismological result.

Seismographic Knowledge

For any given earthquake, the seismographs obtained from different stations at increasing distances from the epicenter are examined and it is found that

1. From 0 to 200 km. there is a compression wave propagated at a more or less constant speed of 5.6 km/ sec^{-1} and a shear wave at 3.4 km sec^{-1}. These are said to be individual waves and are written as Pg and Sg.
2. In 1909, A. Mohorovicic found two sets of P and S waves. There was a difference in the travel times of the first and second impulses of P and also in those of S. The Pg (5.6 km/sec^{-1}) attenuated progressively, disappearing completely at a distance of 200 km. from the epicentre. The normal wave P, however, could still be found at a distance of 11500 km from the focus.

Moreover further from the epicenter reflections were much smaller. Mohorovicic concluded that the additional impulses had traveled by some route other than the direct path from the epicentre to the recorder. This means that there was a discontinuity at a depth of some 50 km separating **a** superficial medium in which the waves moved at low speed from a deeper one in which wave speeds were much higher. The P and S waves travelling in a deeper layer, on reaching the upper boundary of this layer, are refracted along it and move through the lower layer with a higher velocity than those Pg and Sg following a direct path. This discontinuity otherwise known as Mohorovicic discontinuity or Moho is the boundary between the crust and the mantle. On a global scale the Moho is shallow under the oceans (some dozen kilometres), deep under mountain chains and intermediate under eroded land masses.

3. Conrad found two wave channels above the Moho. The upper channel had waves at 5.6 km sec^{-1} (Pg) and 3.36 km Sec^{-1} (Sg). The wave channel in the lower

channel however was P_b = 6.3 km sec^{-1} and S_b = 3.6 km sec^{-1}. The implication is that the crust itself is divided into two parts-the upper crust separated by a discontinuity (Conrad discontinuity at 20 km) from the lower crust.

4. From 800 km to 11500 km (=103°) the Pg and P_b waves are progressively dampened so that only the normal waves (P) reach the stations.
5. From 11500 km to 14000 km (=142°), no waves are received directly by the stations, this is the shadow zone.

Beyond 142° the P waves are found to appear again in a modified form and without the S vibrations. The slowing down of the P waves and the complete elimination of S waves can be interpreted thus.

The slowing down of the P waves was due to their having passed through matter of different composition from that near the surface. The material evidently lay at greater depth than that penetrated by the waves received at 103° and is due to the presence of core of different composition within the Earth. Further, the loss of S waves means that they must have passed through material without any rigidity and hence became extinct (since S waves cannot be transmitted through liquid, which has no rigidity).

The increase in P wave velocity and its slowing down and refraction enables the depth of the material to be computed. By determining where S waves are and are not received on the far side from a disturbance, the dimension of the liquid material (the core) can be mapped. Thus, at 2900 kms a discontinuity exists, known as the Gutenberg-Wiechert discontinuity, which defines the mantle-core boundary.

Thus, on the basis of seismic investigation, the Earth can be divided into three major zones.

1. The outer superficial layer called crust, extends down to 30 to 40 km beneath the continents and even further beneath some mountain regions and to about 10 km beneath sea level in oceanic regions. At the base of the crust, earthquake waves increase abruptly in velocity as they enter a denser layer, the mantle. This boundary is called the Moho or M discontinuity.
2. The mantle extends from the Moho to 2890 kms. The mantle is a solid layer and is itself divided into three layers - an upper mantle from Moho to 400 kms, an intermediate mantle from 400 to 1000 km and a lower mantle from 1000 km to 2890 km.
3. At the base of the mantle, there is an abrupt reduction in the velocity of P waves and the disappearance of S waves. This discontinuity known as the Gutenberg-Wiechert discontinuity defines the core mantle boundary. The core-is a liquid at least in its outer part. The inner core (5150 to 6370 km) is solid and is composed largely of nickel and iron.

Additional information on the physical properties of the Earth's mantle and core may be obtained from an analysis of the free earth oscillations of the Earth. In P and S and ordinary seismic wave transmission, the motion is looked upon as a series of traveling disturbances which affect only a relatively small part of the Earth at any given time, without reference to what is happening at that time to the whole Earth.

In the Chilean earthquake of May 1960, in addition to the regular P, S and surface waves, free earth oscillations were recorded for the first time in history which set the whole Earth vibrating as a single unit like a bell for as long as several weeks. The tone of the Earth's vibration is pitched too low for the human ear to hear but modern seismographs are sensitive enough to detect these low frequency oscillations.

There are two classes of such oscillations, torsional (or toroidal) and spheroidal. In the torsional mode, there is no displacement at the equator and the two hemispheres oscillate in antiphase. The fundamental spheroidal oscillation is an alternating compression and rarefaction of the whole Earth. The next higher mode is the three zones. As the sphere oscillates it is distorted alternately into an oblate and prolate spheroid. Its period is 53 minutes.

There are higher modes with an increasing number of subdivided zonal distributions and each of these modes also has overtones with internal nodal surfaces corresponding to each fundamental. Each oscillation period observed, supplies a value which must be fitted by acceptable distributions of the Earth's density, compressibility and rigidity. Moreover, whereas the immediate data from P and S waves yield only the quotients of the elastic moduli and density, the free earth oscillations are not tied to these quotients.

The free oscillations excited by a major quake last for several days but their amplitude diminishes because the Earth is not a perfectly elastic body. The precise way in which these oscillations diminish can be determined for each mode of oscillation. From these observations information on the elastic properties of the Earth's interior can be obtained.

Earth's Layer

The Earth can be classified on the basis of either its chemical composition or mechanical properties.

Layers of Differing Chemical Composition : Three compositional layers are recognised on the Earth—core, the innermost layer, mantle, the intermediate layer and crust, the outermost layer.

At the centre of the Earth is the solid inner core. It is about the size of the Moon but has approximately the density of pure iron or an iron-nickel alloy. It is generally thought to have frozen out of the liquid outer core. The outer core is molten but is probably close to the freezing point. The inner core is, therefore, suspended in a relatively low-viscosity fluid and is fairly isolated from the rest of the Earth.

The outer core extends from the boundary of the inner core (5149 km depth) to the core-mantle boundary which is at depth of 2891 km, about half of the radius of the Earth. The outer core does not transmit shear waves and is, therefore, a fluid. The density of the core is about twice the density of the mantle and this also contributes to the velocity drop. Seismic waves entering the core from the mantle therefore refract downwards.

It has been concluded that the outer core is not much more viscous than water, and may even be more than twenty orders of magnitude less viscous than the mantle. It therefore converts readily and cannot support large internal temperature or chemical gradients. The outer core is probably the most homogenous part of the Earth but this does not rule out light layers at the top and dense layers at the bottom where material may have settled out. In fact, the inner core may have formed from iron particles settling through the outer core. The core seems to have cooled over time and as it cools, crystals of pure iron may form from the iron-oxygen (and/or sulphur) mixture, which has a lower freezing temperature. Production of these crystals will induce a form of chemical convection and this may help stir the core and provide some of the energy to drive the terrestrial 'dynamo' and generate the Earth's magnetic field.

Seismic waves reflect well off the core-mantle boundaries (CMB), good evidence that the boundary is sharp and exhibits a large change of velocity and density over a fraction of a seismic wavelength. There is an irregular solid layer just above the CMB, which has a thickness of 200 to 300 km. This is called the "D" layer. This layer is variable in both velocity and thickness and in some places is separated from the overlying mantle by a sharp but small discontinuity.

In some places the shear velocity gradient in this region is negative, i.e., the velocity *decreases* with depth. These features are best explained by the existence of a chemically distinct layer at the base of the mantle and this layer is also a thermal boundary layer. The core is convecting and is losing heat to the overlying cooler mantle.

The CMB represents the largest density contrast in the Earth. It is therefore a natural collection point for any light material leaving the core of dense material settling out of the mantle.

The lower mantle is the largest subdivision of the Earth. It extends from the top of "D" (about 2740 km depth) to the major seismic discontinuity at a depth near 650 km. The lower mantle is 49.2 per cent by mass, of the Earth and 72.9 per cent of the mantle plus crust. The predominant mineral in the lower mantle is having the composition (MgFe) SiO_3.

The second most abundant mineral is probably (Mg, FeO) in the NaCl or rock-salt structure.

The next important feature of the mantle is the 650 km discontinuity (sometimes called the 670 km discontinuity, but it may vary in depth from place to place by 50 to 100 km).

The region of the mantle between the 650 km discontinuity and another mantle discontinuity at 400 km is known as the transition region, being the transition between the upper and lower mantle.

In the upper mantle, down to about 400 km depth, the seismic velocities are consistent with a mixture of olivine and orthopyroxene (peridotite), or garnet and clinnopyroxene (eclogite), or a mixture of peridotite and eclogite (so-called fertile peridotite). The deepest samples, from kimberlite pipes, come from as deep as 200 km and these are primarily peridotite although eclogites are not uncommon.

Basalt is the predominant material that reaches the surface from the interior of the Earth. A variety of evidence suggests that basalts separate from their immediate parent at depths shallower than about 100 km, but the ultimate source region may be much deeper, perhaps in the transition region. Buoyant upwelling in the mantle is probably responsible for much of the lateral heterogeneity of the upper mantle, which is being mapped by seismologists using the methods of seismic topography.

Mechanical Classification

Lithosphere : Because they are so close to the cool outer surface of the Earth, the upper 80 to 100 kilometers of the upper mantle also are rather cool and rigid like the crust and move along with the crust as a unit. This combined cool rigid outer region, which includes both the crust and top layer of the upper mantle, is called the lithosphere. Although we use considerable vertical exaggeration in our drawings, the lithosphere is still extremely thin in comparison to its width. Its relative dimensions are thinner than those of an egg shell, for example. The lithosphere is divided into several large fragments called plates, and the motion of these surface plates over the years is referred to as plate tectonics. The lithosphere appears to be quite complex, especially beneath the continents, where it sometimes includes fragments of former crustal plates that have been thrust downward during collisions.

Asthenosphere : Immediately beneath the lithosphere, at a depth extending from about 100 to 200 kilometers, is the low velocity zone. The name is derived from the relatively slow speed of seismic waves traveling through this region. Compared to the lithosphere above, this region is more plastic or less viscous, that is, it softer, more pliable, and capable of bending or deforming without breaking. The higher temperatures at these depths cause some partial melting of the materials, which means that some materials melt or soften and lubricate the motion of others that are more rigid or resilient. Beneath the low velocity zone is no sudden or decisive change in physical properties like occurs at the top where it abuts the lithosphere. The pressure increases with depth, which causes the speed of seismic waves to increase as well.

The entire relatively plastic region of the upper mantle, including the low velocity zone and some of the material beneath it is called the asthenosphere. Scientists do not completely agree on the lower boundary of this region, but many now view it as extending down to the 670-kilometer-deep base of the upper mantle. From this viewpoint, we could divide the upper mantle into two regions the upper 80 to 100 kilometers of cool rigid material than together with the crust make the lithosphere, and the lower 570 to 590 kilometers of warmer and more plastic material that make up the asthenosphere.

It is important to remember that descriptive words like "soft", "plastic", or "movement" are written from a geological perspective, not a human one. Although the asthenosphere is soft compared to the lithosphere, it is still much more rigid than steel, for example. Furthermore, the movement we refer to is on a time scale of millions of years, not human lifetimes. Things that bend or flow over millions of years can be quite resilient to the blow of a hammer.

Mesosphere : Mesosphere includes the earth's zone that lies below the asthenosphere and includes the whole of mantle.

Barysphere : The term now less used includes the whole of core.

Pressure of Earth

The pressure deep in the earth is reasonably well known, but the temperature is less well known. The pressures are due to the weight of the overlying material, and, with our knowledge of specific gravity gained from seismic studies, can be calculated from the law of gravity. These pressures are hydrostatic; that is, they are equal in all directions because the rocks in the mantle and crust are not, as we will see, completely rigid, even though they are solid. A simple analogy will illustrate hydrostatic pressure. Bricks piled one on the other exert a pressure only on their bases, because they are rigid. A pile of sand, however, unless confined by a wall, will assume a cone shape because the sand is not rigid; hence, the pressure due to its weight is exerted in all directions. Data from drill holes and deep mines reveal that the temperature rises with depth in the earth at the approximate rate of 1°C per 27 meters (1°F per 50 feet). If this rise continues to the center of the earth, the temperature there would be 222,000°C (400.000°F), an unreasonably high temperature—hotter than the sun. The temperature in the earth is estimated from knowledge of the melting points of the materials assumed to form each layer, taking into account the rise in melting point at high pressures.

Important Terms

Anisotropic medium
Asthenosphere
Barysphere
Conrad discontinuity
Core
Crust
Free earth oscillations
Gutenberg—Weichert discontinuity
Isotropic medium
Lithosphere
Love wave
Mantle
Mesosphere
Meteorites
Mohorovicic discontinuity
Primary wave
Rayleigh wave
Reflection
Refraction
Rigidity modulus
Secondary wave
Sesmic waves
Shadow zone
Snell's Law
Thermal Boundary Layer
Wave channel

Earth's Interior

The interior of the earth and its composition has always remained a matter of great controversy among the geologists and geo-physicists. At present, a lot of reliable knowledge is available about the composition and structure of the earth. In fast the surface of the earth has been adequately sampled and analysed.

However, the deepest hole in the earth (a drill hole) is only about 8 km deep, and there is no method of sampling from greater depth. Since there is no way of finding the chemical composition of the unseen or inaccessible material, ideas on the composition of deeper regions must be based on indirect evidence, and therefore are somewhat speculative.

In the absence of direct evidence, the physical properties of the inaccessible regions of the earth can be measured or estimated more readily. The change in temperature, pressure and density with depth can be estimated from the velocity of earthquake waves through the earth. The thermal and physical state of the interior of the earth also helps in ascertaining the structure and composition of the earth.

Earth's Temperature

It is an established fact that as we go down from the surface, inside the earth, the temperature goes on increasing at the rate of 1°C for every 32 metres of descent. At this rate the temperature at the depth of 48 km (asthenosphere) would be between 1,200°C and 2,000°C. The rocks and minerals cannot remain in a solid state at such a high temperature. It is, therefore, inferred that the source of lava eruption of the volcanoes is at a depth of about 48 km (30 miles). If we assume that the temperature goes on increasing at this rate (1°C after every 32 metres), the temperature at the centre of the earth should be more than 4,000°C. It has also been concluded by the earth scientists that the rate of increase of temperature inside the earth undergoes a sharp decrease at greater depths from the surface. In the upper layers of the earth an important source of the heat is radioactive minerals like uranium and thorium. These minerals are more abundant up to the depth of about 100 km, below which they are found in much lesser quantities. It, thus, appears that the rate of increase in temperature decreases downwards with increasing depth. The thermal conditions of the interior of the earth may be summarised as under:

1. At a depth of about 48 km the temperature is about 1,100°C.
2. The temperature at the depths of 400 km and 700 km is about 1,500°C and 1,900°C respectively.

3. The temperature at the junction of the mantle and the outer molten core (i.e., at a depth of 2,900 km) is about 3,700°C.
4. The temperature at the junction of the outer molten core and the inner solid core (i.e., at a depth of 5,100 km) is about 4,300°C.

The pressure exerted by the weight of the atmosphere inside the earth has also been used to determine the composition and structure of the interior of the earth. One atmospheric unit equals to a pressure of about 14.7 lb per sq inch. At this rate, at a depth of 2,500 km (1,500 miles), the pressure is about one million atmospheres and in the centre of the earth the pressure is estimated to be about 3.5 million atmospheres. Such a high pressure in the interior of the earth exercises a powerful influence on the temperature and physical state of the earth.

Average Density : The average density of the earth is 5.5. The surface layer of the continents, composed of *sial* (silica+ aluminium) or granite rocks, however, has a density of about 2.7. From these facts it may be inferred that the density of materials in the core of the earth is much more than the density of rocks found in the uppermost layer. The material in the core of the earth is probably 10 to 12 times heavier than water. It is believed that the core of the earth consists of *nife* (iron + nickle).

The density of the intermediate layers is about 4.3. It consists of *sima* (silica+magnesium).

The geologists have consensus on the point that the earth is composed of several shells or layers, the density of which goes on increasing with depth.

New Waves : The behaviour of seismic waves in the different layers of the earth provides the most authentic evidence about the composition and structure of the earth. The different types of waves, generated during the occurrence of an earthquake, are generally divided into three broad categories: (i) primary waves, (ii) secondary waves, and (iii) surface waves. Seismic waves—both P-waves and S-waves—travel faster through rigid material than through soft or plastic material. The velocities of these waves travelling through a specific part of earth thus give an indication of the type of rock there. Abrupt changes in the seismic wave velocities indicate significant changes in earth's interior.

Primary Waves : These are also called as longitudinal or compressional waves. In this type of wave motion, particles of the medium vibrate along the direction of propagation of the wave. These are the high frequency, short wavelength, longitudinal waves. These waves travel not only through the solid part of the earth but also through the liquid part of the core.

A primary wave travels with fastest speed through solid materials, and under certain circumstances, it can change into a secondary wave on refraction, or vice versa. In the liquid materials, their speed is slowed down. These waves are analogous to sound waves wherein particles move both to and fro in the line of propagation of the ray. Much of our knowledge of the internal structure of the earth has been gained from the study of primary and secondary waves.

Secondary Waves : These are also called as transverse or distortional waves. Secondary waves are analogous to water ripples or light waves, wherein the particles move at right angles to the rays. A secondary wave cannot pass through liquid materials. These are the high frequency, short wavelength waves which are propagated in all directions from the focus and travel at varying velocities (proportional to density) through the solid part of the earth's crust, mantle and core.

Surface Waves : Surface waves are called as long-period waves. These waves generally affect the surface of the earth only and die out at smaller depth.

The surface waves are characterised with low frequency, long wavelength, and transverse vibrations which develop in the immediate neighbourhood of the *epicentre.* The surface waves are responsible for most of the destructive force of earthquakes. They are confined to the outer skin of the crust. They cover the longest distance of all the seismic waves.

When an earthquake occurs the seismic waves are recorded at the epicentre with the help of seismograph. In the beginning a few small and weak swings are recorded. Such tremors are called as 'the first preliminary tremors'. After a brief interval 'the second preliminary tremors' are recorded and finally 'the main tremors' of strong waves are recorded.

Seismic Waves as Probes of Earth's Interior : Seismic waves passing through the earth are refracted in ways that show distinct discontinuities within earth's interior and provide the basis for the belief that earth has: (1) a solid inner core, (2) a liquid outer core, (3) a soft asthenosphere, and (4) a rigid lithosphere.

As stated above, the seismic waves are similar in many respects to light waves, and their paths are governed by laws similar to those of optics. Both seismic vibrations and light vibrations move in a straight line through a homogeneous body. If they encounter a boundary between different substances, however, they are reflected or refracted. Familiar examples are light waves reflected from a mirror or refracted (bent) as they pass from air to water.

If the earth were a homogeneous solid, seismic waves would travel through it at a constant speed. A *seismic ray* (a line perpendicular to the wave front) would then be a straight line. Early investigations, however, found that seismic waves arrive progressively sooner than was expected at stations progressively farther from an earthquake's source. The rays arriving at a distant station travel deeper through the earth than those reaching stations closer to the epicentre. Obviously, then, if travel times of long-distance waves are progressively shortened as they go deeper into earth, they must travel more rapidly at depth than they do near the surface. The significant conclusion drawn from these facts is that the earth is not a homogeneous, uniform mass but has physical properties that change with depth. As a result, seismic rays are believed to follow curved paths through the earth.

In 1906, scientists recognised that whenever an earthquake occurs, there is large region on the opposite side of the earth where the seismic waves are not detectable. To better understand the nature and significance of this *shadow zone*.

For an earthquake at a particular spot (labelled ‘0°’), the shadow zone for P-waves invariably exists between 103 and 143 degrees from the earthquake focus. Evidently, something deflects the waves from a linear path. The best explanation for this shadow zone is that earth has a core through which P-waves travel relatively slowly. Seismic rays through the mantle follow a curved path from the earthquake’s focus and emerge at the surface between zero and 103 degrees from the focus (slightly more than a quarter of the distance around the earth).

In 1914, Beno Gutenberg, a German seismologist, calculated that the depth to the surface of the core is 2,900 km. Later analysis of more numerous and more reliable seismic data showed that Gutenberg’s original estimate was remarkably accurate, with a probable error of less than two-thirds of 1 percent. This suggests the presence of a solid inner core, which deflects the deep, penetrating P-waves.

The core has even more pronounced effect on S-waves, but this effect cannot be explained by reflection or refraction. S-waves simply do not pass through the core. There is a huge shadow zone extending almost half way around the earth, opposite the earthquake’s focus. One difference between P-waves and S-waves is particularly significant.

P-waves pass through any substance— solid, liquid, or gas. S-waves, however, are transmitted only through solids that have enough elastic strength to return to their former shapes after being distorted by the wave motion. They cannot be transmitted through a liquid. The fact that S-waves will not travel through the core, therefore, is generally taken to mean that the outer core is liquid.

The Discontinuities : Seismologists have located within the earth two major layers which separate S zones within the earth having markedly different properties. The outer one—the *Mohorovicic Discontinuity*—separates the crust from the mantle, its average depth being 35 km. Separating the mantle from the core is the *Gutenberg Discontinuity* at about 2,900 km.

There, S-waves stop, and the velocities of P-waves are drastically reduced. The outer core is thought to be made of molten iron mixed with some light elements like Si, S, O, C, or H. The extra component is needed to explain the density of the core, about 10 percent less than pure iron.

Other discontinuities are apparent, but less striking. The first occurs between 5 and 70 km below the surface. This is known as the *Mohorovicic Discontinuity* or simply *Moho,* after Andrija Mohorovicic, the Yugoslavian seismologist who first recognised it. The discontinuity is considered to represent the base of the crust and heralds an important compositional change from the feldspar-rich *(sial)* crust to the olivine-rich *(sima)* mantle. Seismic studies show that the continental crust is much thicker (25 to 70 km) than oceanic crust (about 8 km).

Perhaps, the most significant discontinuity, however, is the low-velocity zone from 100 to 250 km below the surface. The normal trend is for seismic wave velocities to increase with depth in the mantle. In this low-velocity zone, however, the trends is reversed, and seismic waves travel about 6 percent more slowly than they travel in adjacent regions. The generally accepted explanation for the low seismic-wave velocities in this zone is that the material is partly molten, perhaps no more than 1-10 percent. The low-velocity zone is included within the globe-enriching *asthenosphere.* This weak layer exists because the mantle is near its melting point. The asthenosphere plays a key role in the motion of tectonic plates at the surface of the earth.

Table below delineates conditions immediately adjacent to the discontinuities, not average uniform conditions (for P-waves and S-waves).

Seismic waves (Velocities in km/sec)

Velocity of P-waves			6.5	16.6	
Velocity of S-waves			3.74	7.4	
Density	Crust	2.95	5.7		Mantle
	Above				
Discontinuity		*Mohorovicic*			*Gutenberg*
	Below				
Velocity of P-waves			3.76	8.1	
Velocity of S-waves			4.36	Not transmitted	
Density	Mantle	3.3-3.5	9.5		Core

Source: Whitten (1977:130).

Seismic Tomography

The seismic tomography, which is like its medical analogy CAT Scan (computer assisted tomography: tomograph is based on a Greek word, *tomos,* meaning section), also proves the given structure and composition of the earth.

In seismic tomography, seismic waves are used like x-rays. Seismologists analyse the velocity of hundreds of thousands of seismic waves as they pass through the earth in different directions. The results are images showing regions where the waves travel faster or slower than normal. Geophysicists and geomorphologists come across from laboratory studies as well as from observations near volcanoes that seismic waves are slowed by unusually hot rocks and are speeded up by cooler rocks. The tomography thus can be interpreted as 'temperature maps'. Hot parts of the mantle, being less dense than their surroundings, will rise, where as cool mantle rocks will sink. Thus, the tomograph can be used to outline the pattern of flow in the mantle.

The three-dimensional view of the mantle obtained from seismic tomography confirms what we might expect from the plate tectonics theory. At a depth of 150 km slow seismic zones occur under most of the volcanic regions including the mid-ocean ridges. In contrast, the shields of Canada, Brazil, Siberia, Africa and Australia are all fast. At a depth of 350 km the mid-oceanic ridge system is no longer continuous but is broken up into isolated segments. At a depth of 500 km there is even less of a relationship between mantle and surface features. This indicates that the mid-ocean ridge system is not simply the surface expression of vertical upwelling currents from the deepest mantle. Instead, it must be fed by the lateral transport of hot material in the upper mantle.

Seismic tomography is also providing a more sophisticated view of the core. Early maps of the core-mantle boundary show that the surface of the core is not smooth, but is marked by swells and depressions with a difference in height up to 20 km. The presence of any kind of topography on the core-mantle boundary bears on a number of fundamental geologic questions. A rough boundary would presumably disturb the flow of the liquid iron in the outer core, much as mountain influences the flow pattern of winds. The topography of the core also has important implications for the flow of energy in the earth. A rough core boundary would imply that a lot of energy escapes the core as heat which might be the source of heat for convection in the mantle and the resulting tectonic plates.

Thus, our newly acquired ability to construct three-dimensional tomographic images of the earth's deep interior opens up the breathtaking prospects of tracing tectonic plates as they plunge below the surface in a subduction zone and descend into the deep mantle.

The interchanges among new tools, new observations, and scientific theories are nicely exemplified by these advances in understanding the earth. Progress in our ability to use remote imaging (seismic tomography) for the distribution of temperature in the mantle has led to new hypotheses about mantle convection patterns. These observations have forced other scientists to reexamine old theories and make new computations to test the validity of suggestions. The resulting computer models have reproduced the distribution and sizes of some observed cold blobs and hot plumes and they have led to predictions about mantle flow patterns. Now, new observations fit the theory.

Many other basic geologic questions must look to the earth's interior for answers. Projects planned for the future include increasing the number of seismic stations so that we might obtain sharper global image of the mantle and the hidden flow that shapes the surface of the earth.

On the basis of the study of the seismic waves and seismic tomography, it may be concluded that the earth has several density zones inside. The behaviour of seismic waves and the tomographic analysis proves beyond doubt that the earth consists of three layers: (i) the crust, (ii) the mantle, and (iii) the core. A brief description of these three layers has been presented below:

The Crust : The outer layers of the earth's structure, varying between 6 km and 48 km in thickness, and comprising all the material above the Mohorovicic Discontinuity. It is divided into two shells, a lower, continuous, layer—the *sima* (acronym of silica and magnesia)—and an upper, discontinuous, layer—

the *sial* (acronym of silica and aluminium). The sial is apparently confined to the continental masses.

Velocity of Earthquake Waves in Sial and Sima

	Sial	***Sima***
Thickness	10-12 km	15-20 km
Density	2.7	2.95
Velocity of earthquake waves	P 5.57 km/sec	6.5 km/sec
S 3.36 km/sec	3.74 km/sec	
Composition	Granite	Basalt

Source : Whitten (1977:109).

The crust, as a whole, is thickest beneath the mountains and thinnest under the oceans. It is composed of various kinds of rocks. In its uppermost part we find sedimentary rocks. This sedimentary layer is not continuous over the entire surface of the earth and is generally thin. The thickness of the sedimentary rocks is less than 3.2 km but in areas of folded mountains this may increase to 32 km or more. Below the sedimentary cover is a layer of crystalline rocks, consisting of granite and gneises in its upper section and basaltic rocks in the lower section. Sometimes these crystalline rocks cover wide areas on the surface of the earth, such as the Western Australia, Peninsular India, Middle Africa, Brazilian Plateau, Eastern Canada, Scandinavia and North-East Asia.

The contact zone of the crust and the mantle is called *Mohorovicic* or *Moho Discontinuity*. Here, the rocks are different in chemical composition from those below and above. The depth of the *Moho* varies from 5 to 7 km beneath the oceanic plains, and 45 to 70 km from the surface in the folded mountain areas.

The Mantle : The layer of the earth between the crust and the core, with its upper boundary marked by the *Mohorovicic Discontinuity* and its lower boundary by the *Gutenberg*

Discontinuity. The depth of mantle varies between 35 km and 2,900 km. The density ranges from 3.3 at the Mohorovicic Discontinuity to 5.7 at the Gutenberg Discontinuity. The mantle is composed of dense and rigid rocks which have predominance of minerals like magnesium and iron *(olivine)*, hence the term *peridotite shell* which is sometimes used. It has been suggested that there are substantial quantities of sulphides in the upper mantle and some nickel-iron in the lower mantle. It has been claimed that minor discontinuities can be detected within the mantle.

The mantle may be divided into two parts: (i) the lower mantle or the *mesosphere;* and (ii) the upper mantle or the *asthenosphere.* The lower part of the asthenosphere like the mesosphere is solid, but the upper part of the asthenosphere is plastic and is in a partially molten condition. The velocity of the earthquake waves decreases in the asthenosphere, and it is, therefore, referred as the 'lower velocity zone'.

The Core : The central part of the earth is known as core. It probably consists of a dense nickel-iron alloy *(nife)* with a temperature estimated at about our 2,700°C. The outer perimeter of the core commences at the Gutenberg Discontinuity, 2,900 km from the surface, where the outer core may be liquid. Within this appears a much denser inner core with a radius of about 1,400 km which may be solid. The density of the core ranges from 9.5 to 14.5 and sometimes even higher. The S-waves, which can pass through only solid objects, suddenly disappear at a depth of 2,900 km. Further, at this depth, the velocity of the P-waves, which can travel through solid, liquid and gases, abruptly decreases from 13.7 km to 8 km per second. This has been identified as the outer limit of the core. To conclude, the velocities of P-waves and S-waves through the earth indicate that the earth has a solid inner core, a liquid outer core, a thick mantle, a soft asthenosphere, and a rigid lithosphere.

7

Oceans and Coasts

Rapidity with which the frontiers have been replaced by boundary lines, in the same rate the vast, and unoccupied oceanic frontier has now become subject to various claims and divisions. The concept of boundary is no longer confined to the land surface itself, rather it has also been extended to the sea. And the interesting aspect is that the land boundary simply affects only two states it separates but a maritime boundary unlike its counterpart on the land, marks the limits of the spatial encroachment of a state's sovereignty into the area of the high seas, and affects many states. There has been little agreement as to the width of the state's political jurisdiction/ extent over the sea. Studies in this category consequently, have been largely legalistic in approach, and little attempt has been made to treat offshore boundaries as part of the general complex of political boundaries.

However, very few geographers have done pioneering works in the field of the law of the sea, concerning the extent of the territorial sovereignty over the adjacent sea. Their works may be grouped into the following categories: (i) those which are concerned with the delimitation of maritime boundaries. In fact, these studies made their greatest single advance at the time of the Hague Conference on the Law of the Sea (1930), and more and more works have been done after the 1958 Conference on the Law of the Sea, and also after subsequent conferences; and (ii) those which are concerned with the exploitation of economic resources such as fish or mineral deposits on the continental shelf and the passage of commercial traffic through international straits. This interest came sharply into focus after 1945 when first the USA and then other countries began to lay claim to exclusive rights on the continental shelf, and when Latin American states began to claim wide areas of the oceans as exclusive fishing zones.

The regional variation which is found on the oceans is not as obvious as the regional variation on land. In one sense, this simplifies the drawing of boundaries because there is no significant debate about 'natural boundaries', although President Jefferson once suggested that the 'Gulf Stream' was the natural boundary of the United States. Boundaries are generally fixed at uniform distances from the coast or some selected baseline. It is also important to note that maritime boundaries are not demarcated, they are marked on charts and it is the responsibility of the navigator to ensure that they are not violated.

Larger part of the oceans unlike the land, is not claimed by individual states, which is parcelled out amongst states. This means that states can actively compete with each other for the resources of the high seas without the involvement of any overriding authority, which is always present on land. This has led to strenuous effort on the part of many countries to formulate a code of international law to govern states' activities on the high seas.

The world's oceans and coastal seas are not permanently occupied as are land areas, and parts of the sea may have a greater variety of use than an equivalent area of land at different but closely related times. States are generally finding it harder to enforce prescribed regulations concerning the activities of individuals in territorial waters than it is on land. The majority of the oceanic resources are more mobile than the corresponding resources on land.

Even petroleum and natural gas could be defined to be mobile resources in the sense that where a field straddles an international boundary, the reserves may be almost completely extracted from the other side of the line. Such a situation has necessitated bilateral agreements on continental shelf boundary. Another important difference between the land areas of a state and its territorial waters is that the same state allows innocent passage of an alien vessel through its territorial water but it does not/cannot allow the same on its land. The law of the sea has taken special care regarding landlocked and geographically disadvantage states, so that they may have access to the continuous seas.

Let us first discuss the histogenesis of the concept of territorial sea-as the spatial expression of the extent of man's political organization over the adjacent sea.

General Notion of Territorial Sea

The concept of territorial sea appears to have its origin with the opening up of new frontiers in the periphery by the European core states as a result of their rivalries which were followed by the Italian wars and the Treaty of Tordesillas in 1494, which tended to divide the yet unexplored world into a Spanish and a Portuguese realm, and the boundary passed through the meridian 370 league west of the Cape Verde Island. But the following centuries witnessed more intense rivalries between the core states over more possessions in the periphery.

The Hollanders successfully challenged the Portuguese, and the English challenged the Dutch, and so on.

Notwithstanding their rivalries in the periphery, the European states were also involved in disputes over fishing rights in the North Sea. The Norwegians, Danes, English and Dutch used to exercise control over various parts of the North Sea and North Atlantic but the limit of the control was vague and not precise. The limit of their control, to a great extent, depended on the capacity of their fleet and fishing vessels. However, it was the Dutch who were among the first to "recognize the need for a zone of water which was to belong to the state, and over which it would possess sovereignty as though it were a piece of its land territory". It was not until the end of the sixteenth century that the question of states' rights to adjacent water developed into a full-scale legal battle.

Early in the seventeenth century the famous Dutch lawyer Hugo Grotius, in his famous *Mare Liberum* argued that no state could control and rule the open sea. Grotius's reaction simply reflected the fact that the Dutch had no large coastal bays and indentations which the English possessed. In response to Grotius' assertion, the English jurist John Seldon in his *Mare Clausum*, published in 1635, put forward the British standpoint, arguing that England owned the seas which surrounded the British Isles and separated them from Europe. Throughout the century, the Dutch stuck to the principle of a narrow belt of territorial sea and their counter part, the English stood firm on the principle of extensive closed seas. But this dichotomy gradually narrowed down with the rapid expansion of merchant fleet, and the English particularly realized the need that the limit of the territorial sea must be properly determined. Still there developed another dichotomy between the principle of effective occupation versus the principle of contiguous belt of territorial sea along all coasts.

It was in the midst of such a dichotomy that the Dutch jurist Cornelius Van Bynkershoek published his famous treatise *De Dominio Maris* in 1702. The essence of his philosophy as contained in the treatise, that states could indeed claim sovereignty over water just as they had over land, seemed to have been stemmed from two basic principles: (i) an unguarded coast should not have territorial waters adjacent to it but if a state desired to have claim of sovereignty over the adjacent waters of its coast, it must get its coast fortified; and (ii) the principle of intended and continuous occupation—a state had the right to claim, for permanent possession, any part of the sea over which it exercised such effective control, whether adjacent to its coast or not. It could be achieved through domination from shore or through the deployment of naval fleet.

Bynkershoek's shore-domination principle in the early eighteenth century tended to reflect "a conception of sea-sovereignty much more modern than anything that had been suggested in the previous century". Since the sea was common to all, he explained that "dominion of adjacent seas, as far as a cannon could throw a shot, was reasonable and could be conceded to those who owned the shore". His proposal that a coastal state should exercise sovereignty over that part of the adjacent sea which it could command by means of guns mounted on the shore came to be generally accepted. Nevertheless, the English preferred the principle of a contiguous belt of equal width, which was subsequently favoured by the Danes, French, and Italians which sought to perpetuate the equal width zone of territorial waters, and the problem, then, was one of determining the exact width of such a belt.

Though the Danes in 1745, claimed a width of one league, which was equal to four nautical miles. The Dutch, while agreeing to a belt of equal width, insisted on using the cannon-shot as their determinant of territorial sea over the adjacent waters. Galiani, an Italian writer, is credited with the proposal of a three-mile limit for the territorial sea from the coast. It was believed, then, that his proposal was based on the maximum range of the cannon-shot/artillery of his days. It is still a matter of controversy whether the maximum range of the eighteenth century artillery was three mile or less than that Nonetheless, it came to be accepted that a line of three nautical miles from the shore represented the limit of the sovereignty of the coastal states, and outside of it lay the high seas.

Though a three-nautical-mile limit was earlier accepted as the maximum limit of the states' sovereignty over the adjacent seas, and the major power in the contemporary world strictly adhered to it. The three-nautical-mile limit of the territorial water with nineteenth century and early twentieth century was more of a political compromise rather than an administrative convenience.

Adjacent Water Claims

With the collapse of the colonial system, followed by the rise of nation-states in the periphery, the national claims to adjacent waters became numerous and variable. It has been rightly observed that "never have national claims in adjacent seas been so numerous, so varied or so inconsistent". The three-nautical-mile limit was never universally accepted though the major powers or the contemporary core states strictly adhered to it.

Variable claims to territorial waters in the post-Second World War scenario appear to be the result of the core-periphery conflict. As more and more nation-states are coming up in the periphery with varied national interests, the claim to their adjacent seas is also changing at the expense of the three-nautical-mile limit.

The leading core states of the present world maintain a three-nautical mile limit for their territorial waters but they strongly denounce the variable and wider claims to adjacent seas by other states. The core states which handle roughly 80 per cent of the world's merchant shipping have always favoured the freedom of the seas over a large part of the water surface of the earth as possible. Variable claims to territorial seas other than the three-nautical-mile limit, would lead to a reduction of the area of the high seas to a greater extent and which would subsequently affect the freedom of the mobility across the seas. The core states normally feel that wider belt of territorial waters would greatly jeopardize their trade and commerce and also the mobility across the straits would be closed down. While the newly emerged coastal nation-states in the periphery feel that narrow belt of territorial water, as claimed by the leading, developed maritime states would greatly hamper their national interests and hence they are no longer bound to adhere to their former colonial masters/rulers. The conflict between the states adhering to a three-nautical-mile limit, and those to wider variable claims has widened much and spread throughout the world.

It was in 1952 that three prominent Pacific coastal states of Latin America—Chile, Peru and Ecuador—issued the Declaration of Santiago, claiming exclusive fishing rights to a line some 200 nautical miles from their coasts. The basis for such a wider claim was that the west coast of Latin America off these states does not possess a potentially rich continental shelf, so these states saw nothing wrong in their wider claims to the world's richest fishing water. The Santiago Declaration in 1952 was in response to the Truman Declaration of 1945 by which the United States extended its claim to the wealth of the continental shelf. Later, Peru and Ecuador laid claim over the entire 200 nautical mile belt not just as a contiguous zone but as territorial waters. However, Chile stuck to a three-nautical-mile limit for its territorial waters.

The United Nations Conference on the Law of the Sea (UNCLOS I) was first held in Geneva in 1958 to discuss the problems arising out of unilateral claims by a great number of newly independent nation-states which tended to threaten: (a) freedom of navigation in high seas, and (b) freedom of innocent passage across the international straits. The UNCLOS

I codified most of what had developed in the field since its earliest days, and also the developments which had taken place since the Hague Conference in 1930. The conference used as the basis for deliberations from draft conventions prepared by the International Law Commission—an organ of the UN General Assembly. There was no agreement, however, on several important issues, notably special fisheries zones under coastal state jurisdiction and the breadth of the territorial sea. In 1960, the number of states claiming three-nautical-mile limit declined though not very sharply but the number of states claiming a 12-mile limit increased. Included in this category of states were China and the erstwhile Soviet Union. A 12-mile limit tended to close down the entrances to the Gulf of Bothnia, the Gulf of Finland, and also to the Straits of Malacca.

The UNCLOS II, also held in Geneva in 1960 could not come up to the expectation and it also failed to solve the pertinent problems. The four Geneva conventions of 1958, then remained with all their imperfections, as the core of the law of the sea. There were several conventions on the territorial sea and the contiguous zone on the continental shelf, on the high seas and on the conservation of the living resources of the high seas. The continental Shelf Commission codified a new concept in international law deriving from the Truman Declaration that "coastal states had jurisdiction not only over an adjacent belt of the sea abut also over the resources of the continental shelf, extending outward on indeterminate distance".

The signing of the United Nations Convention on the Transit Trade of Landlocked States in 1965 at New York was a significant development in the sense that the geographically disadvantaged states acquired for themselves the right to approach the sea through their neighbours' territories.

By 1971 a number of Latin American states (which included Argentina, Uruguay, Brazil, Panama, Nicaragua and El Salvador) claimed the 200-mile, limit either as territorial sea or for the exclusive fishing rights. In Africa, Guinea and Senegal claimed a 130-mile limit while Sierra Leone announced a claim of 200-mile limit. India sought for a 100-mile limit for fishing. It was interesting to observe that the states which strictly adhered to the principle of the three-mile limit were nevertheless, extending their privileged fishing areas to the 12-mile limit including the United States.

With the increase in science and technology on the one hand and more and more wider claim over the adjacent waters, both as contiguous zone and territorial seas on the other there was an intense scramble between the states. However, it was largely felt that the "seabed and ocean floor beyond the limits of present national jurisdiction be reserved exclusively for peaceful purposes and that their resources be used in the interests of mankind, and these resources be declared the common heritage of mankind that they be used primarily for the benefits of the poorest countries and an international agency be created to assume jurisdiction over the area". This was the feeling of most of the nation-states which emerged in the periphery. This initiative on the part of the newly independent nation-states set off a chain of events which led to the UNCLOS III.

The UNCLOS III which opened with a brief organizing session in New York in December 1973, had its first working session in Caracas for 10 weeks in 1974, and numerous other sessions in New York and Geneva, concluded in December 1982 with the signing of the convention. Till 1984 some 159 states and other entities (not including the United States) had signed the convention and ratified by 14. The United States' non-participation may be attributed to some control which the UNCLOS III placed on the indiscriminate use of the seabed resources, and the attempted creation of the international seabed area. In the UNCLOS III itself, an attempt was made to universalize the adoption of the 12-mile limit, but it was opposed on the ground that a 12-mile limit would close off all maritime passages less than 24 miles wide. Indonesia and Malaysia both have opted for a 12-mile limit which had once closed off the Straits of Malacca to the foreign vessels. The United States and former Soviet Union threatened military action against Indonesia and Malaysia. Though these two South-East Asian states adhere to the 12-mile limit, they provide safe passage to the foreign merchantships. All coastal states with straits between them have agreed to provide safe passage to commercial vessels, nevertheless, the limit of their territorial waters exceed the width of the straits. As the 200-mile claim is fast becoming a common practice, there is every apprehension that if the limit is given universal recognition, then at least one-third of all the earth's water surface would cease to be high seas, all passages and channels between islands and between continents and islands would fall under national jurisdiction.

Claim Variable Distribution

Since there is no universal limit to territorial waters, there are variable distribution of claims, ranging from the three-mile limit to the 200-mile limit. Till January 1984, some 26 states adhered to the three-nautical-mile limit. Prominent states to this category were Denmark, the Netherlands, erstwhile German Democratic Republic, erstwhile German Federal Republic, United Kingdom, United States, Belgium, Ireland, Australia, Chile, Singapore, United Arab Emirates, Jordan, and Bahrain. Most of the states in Europe which had earlier developed the 3-nautical-mile concept belonged to this category. There were only two states—Finland and Norway—to have a four-nautical-mile limit. The six-nautical-mile limit was claimed by Dominion Republic, Greece, Israel, Lebanon and Turkey. However, Turkey lays a 12-nautical-mile limit over the Black Sea.

By the mid-1980s, the number of states, claiming a

12-nautical-mile limit increased substantially. Nearly a half of the total independent sovereign states of the present world exercise their sovereign jurisdiction over a 12-nautical-mile limit. Some of the important states to this groups are France, Iceland, Poland, Portugal, Romania, Sweden, Italy, China, former Soviet Union and Ukrainian SSR, India, Bangladesh, Pakistan, Indonesia, Malayasia, Sri Lanka, Thailand, Myanmar Japan, Iran, Iraq, Saudi Arabia, Canada, Columbia, Venezuela, Mexico, South Africa, Morocco, Algeria, Egypt, Sudan, Ethiopia, Libya, etc.

Ivory Coast, Kenya and New Zealand had earlier claimed a 3-nautical-mile limit, but in the 1980s they have extended claims over a 12-nautical-mile limit. Similarly, Cambodia, now Kampuchia, had, in the 1970s, a 5-nauticalmile limit of its territorial water but in the mid-1980s, it extended its claim to a 12-nautical-mile limit. A 12-nautical-mile limit, as claimed by a substantial number of states, in the late 1980s, has undoubtedly put a great strain on the freedom of seas. There is no denying that more and more states in the coming days would lay claim to a 12-nautical-mile limit. Most of the states in this category are those which have come up in the periphery/semi-periphery of world economy. These states felt that by widening their territorial seas, they would gain more access to the marine resources, particularly fishing, and would secure a 'security belt' along their coast.

Albania in the mid-1980s, claimed a 15-nautical-mile limit, while Angola to a 20-nautical mile limit. Nigeria and Togo exercised a claim over a 30-nautical-mile limit, while Syria laid a claim to a 35-nautical-mile limit. Madagascar, Cameroon, and Tanzania claimed a 50-nautical mile limit, while Gabon to a 100-nautical-mile, and Senegal to a 150-nautical-mile limit. Some fifteen states, mostly African and Latin American, such as Argentina, Brazil, Peru, Ecuador, Ghana, Liberia, Somalia, Congo, etc., have laid claims to 200-nautical-mile limit.

Since there is no universally accepted limit to territorial sea, and no unanimity among the nations of the world with regard to a common width to the territorial seas, individual states are making unilateral claims dividing the oceanic surface into hapazard ways, much to the detriment of the freedom of seas.

Territorial Sea Requirement

It was the conflict between the core countries with regard to the opening of the new frontiers in the periphery on the one hand and conflict between them over the fishing in the regional seas on the other hand, and more recently the core-periphery relationship/conflict in rapidly changing world economy, which seemed to have necessitated the extension of sovereignty over the adjacent seas or waters, i.e., the territorial sea.

Development of naval fleet in the late seventeenth century, followed by the scramble for the oceans among the European states, particularly between The Dutch and English, quite often led to several naval wars between them in the following centuries. Threatened by the invasion from the seas, the European states, particularly those of the Norwegians, Danes, English and the Dutch, felt the need for a protective zone along the adjacent seas of their territory. It was in this context probably, Van Bynkershoek developed his shore-domination principle, followed by Galiani's 3-mile width suggestion for the extension of the states' sovereignty over the adjacent seas/waters.

Naval wars, therefore, seemed to have demonstrated the need for the territorial water repeatedly. All earlier treaties, concerning the maritime boundaries between the European maritime states, were aimed at maintaining the security zones. Even a state which sought to remain neutral also felt the necessity of a protective territorial sea. Defence, therefore, has always remained the most important requirement/function of the territorial sea. The state has every right to exclude or to search suspicious vessels within its limit, to erect defensive works in the sea, and to lay mines. The state can torpedo any ships of the alien state, if it ventures to enter within the limits of its territorial waters. There are examples of coastal states having torpedoed the enemy ships in the recent past.

In the earlier phase of the concept, it was the defence of the maritime states which was more important than anything else. Notwithstanding the military significance and defensive function of the territorial sea, the principle that sovereignty extended over the territorial sea obviously conferred upon the state an exclusive right to fish in this area. The North Sea has long remained a zone of potential conflict between the Norwegian, Danes, Dutch and the English, for fishing which quite often led to frictions between themselves.

The right to fish was disputed and the fishing vessels of stronger states used to fish in the adjacent waters of the alien states. The Dutch fishing vessels used to fish in the adjacent waters of Iceland, which was then under the possession of Denmark. Similarly, the British fishing fleets also used to fish in the waters of Iceland. It was not until the end of the sixteenth century that these states felt the necessity of their right on adjacent/neighbouring waters. However, it was in the mid-seventeenth century that the states exercised fishing rights over a belt of 24 miles in their neighbouring waters. But soon this 24-mile limit for fishing rights was contradicted as a result of the Dutch-English rivalry, which sustained for decades, finally led to some multilateral arrangements with regard to the fishing rights, and also saw the rise of the concept of territorial sea.

These arrangements were: (i) coastal states to have exclusive fishing rights in their territorial seas; (ii) fishing rights in the territorial waters would be indisputable; (iii) coastal states to have the right to arrest and fine fishermen of other coastal states in their territorial waters, and the laws of the coastal states' to be applied in case of illegal fishing by other coastal states; and (iv) coastal states might allow foreign fishermen to operate within their territorial waters but such permission required to be done under international norms and agreements.

Iceland is that island-state whose national economy, to a greater extent, depends on fishing. Its waters had been much frequented by the United Kingdom and Germany, which particularly had a serious impact on Iceland's national economy. In 1958, the parliament of Iceland authorized the state to extend control to a distance of 12 miles. As a result, the foreign fishing vessels lost the right to fish in about 10,560 square kilometres of water. The United kingdom in particular, ridiculed the move of Iceland and continued to fish under naval protection. At one stage naval war between the two seemed inevitable on this issue. At last, the United Kingdom accepted Iceland's claim in view of the importance of fishing in the state's national economy.

Fishing Claim

In recent years number of claims have been made by coastal states to fish beyond the limit of their territorial waters for two reasons: (i) to protect the fishing industry of the state in question, and (ii) to prevent the depletion of certain fish species. There is a kind of unanimity in this regard that a state may legitimately claim to exercise some kind of control, outside the limit of its territorial sea, short of complete sovereignty, and that this control may in certain cases extend to the fisheries. All those states which have laid claims to a 12-nautical-mile limit of their territorial waters, must have done it keeping in view their exclusive fishing rights.

The Permanent Court of International Justice has settled a number of fishing disputes between the states, one of such settlement was between the United Kingdom and Norway in the 1950s. A number of bilateral agreements have been achieved between states with regard to the fishing of certain types of species, e.g., the United States and Canada have agreed to limit salmon fisheries in certain areas of the high seas off the coast of the Pacific North West. Recently Russia and Japan have signed an agreement, in which Japan has been allowed fishing to a limited extent in the Sea of Okhotsk to which it has, hitherto, remained excluded.

Territorial Sea Importance

The importance of the territorial sea has been further enhanced by the discovery of the mineral potential of the continental shelf. But the discovery of oil from the continental shelf has, in fact, demonstrated better than any other factor for the political division of both the surface of the sea and the underlying rock.

The UNCLOS III has given specific recognition to this importance of the territorial sea that the state within its limit in its territorial water, has exclusive right to the seabed resources, particularly its mineral resources. These resources are inviolable and protected under international seabed area. Had there been no territorial water limit, the powerful maritime states would have made these seabed mineral resources violable. With the growth in science and technology on the one hand, and rapid depletion of the land-based resources on the other, there has been increasing effort to tap the seabed resources. Territorial sea has offered manifold flexibility in this regard. The powerful core states dare not exploit seabed resources within the limit of territorial waters of the peripheral states. However, this can be done only with the permission to do so.

Maritime boundaries provide protection to coastal states against smuggling. Smuggling has always been a corrupt practice aiming at destroying the internal economic order of the state, creating chaotic conditions. Some of the most expansive claims to jurisdiction over the sea from time to time, have been made by coastal states, irrespective of being core or peripheral states, which were aimed at checking the practice of smuggling. The states may intercept and search any vessels not only within its territorial waters but also beyond the limit of its jurisdiction.

Most of the maritime states in the eighteenth and nineteenth centuries felt the need to search and intercept foreign vessels which were found to be involved in unlawful trade/activities in their adjacent waters. Great Britain in the eighteenth century, extended its 'fiscal jurisdiction' on several occasions. It started with a 6-nautical-mile limit to 300-nautical-mile limit for that jurisdiction. By doing so it sought to perpetuate the right to protect the revenue by suppressing smuggling. In 1876, notwithstanding the British claim, most of the North Sea littoral states agreed on a 27-nautical-mile limit for their fiscal jurisdiction to curb smuggling and unlawful trade in their adjacent water. However, the USA laid claim only to 12-nautical-mile limit and Spain in 1874-75 claimed a zone of 18-nautical-mile limit for fiscal jurisdiction to intercept and search foreign vessels, engaged in unlawful trade and smuggling.

Practically all states, irrespective of being core or peripheral nations, are unanimous that jurisdiction should be taken beyond the limit of the territorial waters for the purpose of securing the fiscal interests and certain other interests. However, states are yet to agree on a common and universal limit for the fiscal jurisdiction. It now depends on the might of the coast guard to intercept and search such vessels which are engaged in unlawful/illegal trade practices, detrimental to the national economy.

Territorial Sea and Defensive Role

The defensive role of the territorial sea which had declined to a greater extent, following the development in the military technology, particularly after the Second World War, has again reappeared. This time it is not the military threat from the neighbouring states or threat from any other maritime nation, but it is from terrorism. With the globalization of terrorism in the 1980s and early 1990s, the 'potential' states (which are prone to terrorist attacks) now feel greater necessity of the right to intercept vessels of suspicious character, much beyond the limit of their territorial water. India is contemplating to extend its right to intercept and search all those vessels which it feels to be involved in supporting terrorist activities on the land, much beyond the limit of its territorial sea.

One of the distinguishable roles of the territorial sea is to function as a tariff wall against foreign goods, and outside competition for its markets so that indigenous products should not suffer and internal market should not be flooded with foreign goods. Thus, the territorial sea provides fiscal protection to the prosperity of local industries and indigenously-built commodities. It is only under treaties and agreements (bilateral or multilateral) that foreign goods are allowed entry through the territorial sea. Custom duties must be paid to the government before taking the foreign goods to the land. The economic law of the state prevails in the territorial sea.

Problems of sanitation and pollution also make it intrinsic that maritime states have jurisdiction of bays and estuaries of great width and territorial seas as well. Of increasing importance today is the need to control the behaviour of ships, particularly those of the oil tankers which normally discharge harmful oily waste into the sea, killing birds and other marine life. Such pollution in the sea may occur either due to accident or some technical defects in the tankers, or in case of war.

In the recent Gulf War a big oil slick struck the shore of the Gulf states, causing extensive damage to marine birds and marine life, and also endangered human life on the shore. Sometimes pollution results from seepage from offshore drilling rigs within the territorial water. In that case the oil company is prosecuted under the environment protection law. ONGC has been fined to pay the compensation by the Government of India for the extensive damage of marine life it has caused off the Bombay coast by its negligence. When a foreign vessel or tanker deliberately or accidentally discharges wastes into the territorial water of a state, the state then has the right to punish the captain of the vessel and seek compensation from the state to which the vessel belongs. There are numerous examples of states having fined and punished foreign vessels for causing pollution and sanitary problems within their territorial waters.

Though there is no international agreement in case of an accident of an oil tanker in the high seas, leading to a big oil slick, yet if the oil slick flows down to the territorial sea of any state, the state may seek for compensation from the state to which the tanker belongs. Some states have proposed a zone of 100 miles from their coasts within which their government would have the authority to check pollution and to take legal proceedings against the vessels (and the states to which they belong also) which would be found guilty of polluting the sea.

It is the manifold function of the modern state system that the politico-geographical necessity of the territorial sea, in the light of the core-periphery relation in the world economy, seems to be highly justified. However, the role of territorial sea has been changing over the years as more and more states are coming up in the periphery and their needs and requirements are charging, and with core states having turned more and more towards the use/exploitation of seabed resources.

Significant Jurisdiction Zones

The sovereignty of a state, technically or legally, ends at the limit of its territorial sea but some measure of control, as we have seen above, extends beyond the limit of the territorial sea further into the ocean. However, there is no clear-cut outer limit to such control. On the shoreward side of the baseline which is regarded not even as part of the territorial sea but the inland waters, enclosed by the base line, which are regarded not even as parts of the territorial sea but as internal waters of the state. UNCLOS I, II and III have recognized seven jurisdictional zones stretching horizontally from internal waters out to the high seas. In some cases, the status of the seabed and subsoil differs from that of the superjacent waters of the zone concerned. The more fundamental rule governing the status and delimitation of the zones will be outlined here.

Characteristics of Internal Waters

Internal waters comprise all waters lying landward of the base line from which the breadth of the territorial sea is measured. They include rivers, lakes, bays, ports and the waters landward of the low tide line. The principal distinguishing feature of the internal waters, as compared to territorial sea, is that the sovereignty of the coastal state in these waters is not limited by a right of innocent passage in favour of foreign shipping. Though the question is not free from doubt, there is probably no right of entry into a foreign port except in distress, unless provided by treaty.

Territorial Sea Breadth

The breadth of the territorial sea has been a matter of controversy for over half a century with claims varying all the way from 3 to 200 miles. Fortunately, it is now likely that the breadth of 12 miles will be generally recognized following Article III of the UN Convention. The coastal states' sovereignty over the territorial sea is limited by its obligation to accord a right of innocent passage to foreign shipping. The increase to 12 miles in breadth of the territorial sea means that many straits through which there was previously a belt of high seas will become territorial sea straits. The 1958 Geneva regime of straits (a re-enforced form of innocent passage) has been replaced in the UN Convention by a regime of 'transit passage', more favourable to foreign shipping.

The normal baseline from which the breadth of the territorial sea is measured is the low water line as marked on the large scale charts officially recognized by the coastal state. The outer limit is the line every point of which is at a distance from the nearest point of the baseline equal to the breadth of the territorial sea. Like the Geneva Convention on the Territorial Sea (1958), the UN Convention makes special provision for the base line on highly undented coasts, at river mouths, in bays and around ports and roadsteads. Straight baselines joining appropriate points on the coastline may be employed where the coastline is deeply undented or there is a fringe of islands along the coasts.

The delimitation of the territorial sea between opposite or adjacent states is effected by reference to a three point formula: (i) by agreement, (ii) by a median line/equidistant line, unless (iii) another line is called for by reason of historical title or other special circumstances.

Under the 1954 Geneva Convention on the Territorial Sea and the Contiguous Zone, the coastal state was entitled (but not obliged) to claim a contiguous zone extending out to 12 miles from territorial sea baselines. The residual status of this zone remained high seas and accordingly, the various freedoms of the high seas continued to be enjoyed by other states. By way of exception (to be restrictively interpreted), however, the coastal state was entitled to exercise the control necessary to (i) prevent infringement of its custom, fiscal immigration regulations within its territory or territorial sea; and (ii) punish infringement of those regulations committed within its territory or territorial sea. Under the UN Convention, this zone has been extended to 24 miles and the residual status is now that of exclusive economic zone but otherwise the main features of the zone have been retained.

Exclusive Fishing Zone

Prior to UNCLOS I and II in 1958 and 1960, no differentiation was generally recognized between the territorial sea and exclusive fishing zones. Following failure to agree upon more extensive breadth for the territorial sea in 1954 and 1960, however, a new trend developed in state practice towards recognition of exclusive fishing zones beyond territorial sea limits. The trend can be traced through a series of bilateral fishery agreements, culminating in the multilateral European Fisheries Convention (1964) and the subsequent series of more extensive unilateral claims such as those made by Iceland. In the beginning, such extensive claims were strongly resisted but, by the 1970s, influenced by the glowing support for the concept of a 200-mile exclusive economic zone, the major fishing states increasingly joined the rank of states claiming 200-mile exclusive fishing zones. The trend in this direction was certainly helped by the decision of the International Court of Justice in the Fishery Jurisdiction Case (1974 United Kingdom vs Iceland) to the effect that, although Iceland's 50-mile fishery limits were not 'opposable' to the United Kingdom, there was an obligation upon the parties to undertake navigation and to take into account, among other things, Iceland's entitlement for a preferential share of the fisheries within these limits.

It is likely that the more comprehensive exclusive economic zone provided for in the UN Convention will eventually be recognized generally. In the meantime, there can be no doubt that the concept of the exclusive fishing zone is already established.

General Notion of High Seas

The Geneva Convention on the High Seas defined the high seas as "all parts of the sea that are not included in the territorial sea or in the internal waters of a state". Given the introduction of the EEZ and of 'archipelagic waters', it was necessary to amend the definition in Article 86 of the UN Convention to "all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a state, or in the archipelagic waters of an archipelagic state".

The principal jurisdictional feature of the high seas is the freedom of the high seas, which in reality comprise a bundle of freedoms. It includes the freedom of navigation, fishing, the laying of submarine cables and pipelines, overflight and others which are recognized by the general principles of international laws. Under the UN Convention, two of these others have been identified: freedom to construct artificial islands and other installations permitted under international law, and freedom of scientific research. Such freedoms have to be exercised with due consideration for the interests of other states in their exercise of the freedom of the high seas and (a new element in the UN Convention) with due consideration for the rights under convention with respect to activities in the 'area'.

The 'area' in question is the seabed and ocean floor and subsoil thereof beyond the limits of the national jurisdiction, for which a new and highly complex deep sea mining regime is being established.

However, the UN Convention has made no special provisions for the mid-ocean archipelagos, despite the fact that states like Philippines and Indonesia had been pressing for recognition of their rights to adopt a baseline system enclosing the archipelago within a series of straightlines joining the outermost islands and reefs of the archipelago. In the UN Convention, however, there is a separate part on 'archipelagic states' which allows such enclosure within 'archipelagic baselines' and creates a new category of 'archipelagic waters' for enclosed sea (though there may also be internal waters within the archipelagic waters). The territorial sea, a contiguous zone, EEZ and continental shelf of an archipelagic state are measured in the usual way, but from the archipelagic baselines.

The UN Convention recognizes the rights of ships of all states to enjoy a right of innocent passage through the archipelagic waters similar to that enjoyed in the territorial sea. It also recognizes, however, the right of the archipelagic state to designate sea lanes and prescribe traffic separation schemes within archipelagic waters. The right of 'archipelagic sea lanes passage' enjoyed by foreign shipping through such lanes is similar to the re-enforced right of innocent passage through territorial water.

Maritime Boundaries

Maritime boundary delimitation is a complicated issue because of both the number of real and permanent boundary situations throughout the world, and the complexities of the delimitation process. There are approximately more than 200 national political units bordering on or located on the oceans. A majority of them are independent and some dependent territories. Virtually all these are entitled to an exclusive economic or fisheries zone, extending to a maximum distance of 200 nautical miles from the coastline, in addition to their territorial waters which are contiguous to the shore and most exclusive zones border on one or more adjacent or opposite zones of other states. In many cases territorial seas and continental shelves of the adjacent/neighbouring states also abut on one another. The result is an almost bewildering array of some 400 or more international maritime boundary statistics throughout the world. In time, all these should be formally delimited.

The delimitation process itself involves several types of issues but the most important being (i) the sources of authority, and (ii) principal methods by which the delimitation is carried—equidistance, modified equidistance or the line based on 'relevant circumstances'.

To date, there are more than 60 states which have claimed an EEZ and more than 30 states claim an exclusive fisheries zone whose geographical dimension are the same as an EEZ. A question here is whether or not a boundary separating the continental shelves of two states need necessarily be the same as the boundary separating their exclusive economic or fisheries zones. In the Mediterranean Sea there are 16 cases of territorial seas of adjacent states abutting on one another. A number of these EEZs face one another across the narrow sea.

Power Avenues

For the territorial sea boundaries, both the 1958 Geneva Convention on the Territorial Sea and the Contiguous Zone, and the 1982 Law of the Sea Convention stipulate that, failing agreement between them to the contrary, states with opposite or adjacent coasts are not entitled to extend their territorial seas beyond the median line. But a caveat is then included to the effect that these provisions shall not apply where it is necessary by reason of historic title or other special circumstances to delimit the territorial sea boundaries in a way which is at variance with the median line provisions. In absence of agreement, it is incumbent on the state favouring a territorial sea boundary other than median line to prove that this variant is necessary.

So far as continental shelf boundaries are concerned, the International Court of Justice (ICJ) made a rule that delimitation should be effected by agreement, in accordance with equitable principles, taking account of all relevant circumstances. This phraseology formed the basis for the early texts of the Convention at UNCLOS III, and only towards the end was there a change in Article 74 (dealing with the boundaries of EEZ) and Article 83 (boundaries of the continental shelf). The texts now read: "delimitation...shall be effected by agreement on the basis of international law as referred to in Article 38 of the Statute of International Court of Justice, in order to achieve an equitable solution."

Article 38 of the Statute states that in its decisions, the Court shall apply (i) international conventions, establishing rules expressly recognized by the contracting states; (ii) international customs as evidence of general practice accepted as law; (iii) the general principles of law recognized by civilized nations; and (iv) judicial decisions and the teaching of the most highly qualified publicists as subsidiary means for the determination of rules of law.

In the absence of an agreement on boundary delimitation, states can go to third party settlement, particularly the International Court of Justice. This procedure has been expanded under Article 27 of the Law of the Sea Convention to the effect that where no settlement of a dispute over maritime boundaries has been reached, states may choose any one of four procedures for settling the dispute: the International Tribunal for the Law of the Sea, the Id, an arbitral tribunal established under the provisions of Annex VII of the Convention, or a special arbitral tribunal constituted under Annex VII of the Convention. However, it has been made clear that this procedure would be applied only to those states which have signed or ratified the Convention or acceded to it. Of the nearly 400 potential maritime boundaries, about 75 have been agreed upon 'with the agreements having come into force.

A third source of authority is the judicial decisions particularly of the International Court of Justice. There have been four major court cases: The North Sea Continental Shelf Cases of 1969, involving the Netherlands, Denmark and the former Federal Republic of Germany; the United Kingdom-France Continental Shelf Arbitration of 1977; the Libya-Tunisia Continental Shelf Case of 1982; and the US-Canada Maritime Boundary Case of 1984. All four have stressed the need for an equitable solution to the boundary dispute, i.e., a solution based on equitable principles.

Delimitation Systems

There are three methods or systems of delimitation. One is the equidistance method which depends on the baselines along the coasts of the respective countries whose offshore areas are to be separated by the boundary. There may be difficulties here if one state utilizes 'normal' baselines, following the sinuosities of the coasts, and the other employs a straight baseline system connecting the outermost islands, promontories and rocks. There is nothing magical about an equidistance limit. It does not lead necessarily to a condition of equity, in which either the total area or the living and non-living marine resources are divided equally between the parties. But it is a technique to be used when other techniques are inappropriate and inadequate. The US-Mexico boundary in the Gulf of Mexico, which has been agreed upon but not yet ratified, is an equidistance line, as in the Puerto Rico-Venezuela boundary and the boundary between American Samoa and the Tokeiau and Cook islands.

The second method is that of modified equidistance in which there are one or more variations in the line to account for particular conditions. There may, e.g., be islands or rocks located some distance off one state's coast. If such features were given full effect in the equidistance boundary delimitation, they would have a disproportionate effect on the location of the line. So the parties agree to ignore the feature completely in the delimitation; to give it partial effect, as occurred with respect to the Scilly Isles in the UK-France arbitration or to describe an arc about a part of the feature.

Rather than rely on baselines which follow the sinuosities of the coast, states may by agreement, define artificial baselines for the purpose of measuring their equidistance-type boundaries, as in the case of the French-Spanish maritime boundary in the Bay of Biscay. The location of specific turning points on the equidistant line may be shifted in order to smooth out the boundary. Small areas on each side of the maritime boundary may be exchanged. But the basic premise remains for a boundary on the equidistance method.

The third category of methods is what might be called 'relevant circumstance' boundaries. These are maritime boundaries whose delimitation was based on criteria other than equidistance. The choice of alternative methods was apparently necessary in order to achieve an equitable solution. There are many forms of relevant circumstances which might be used as a basis for such a boundary but a few of them are to be mentioned here.

One form of relevant circumstance is natural prolongation. The argument is that a state's adjacent continental shelf is a natural extension of the land territory into and under the sea. Particularly in cases where the shelf adjacent to a coastal state extends beyond the median line out towards a structural depression in the seafloor, it is argued that the state should have control over the whole undersea area. An example here is the Chinese claim to the floor of the East China Sea beyond the median line with Japan in the Okinawa Trough.

Another circumstance involves the coastal front theory. A country should have jurisdiction over the seabed and water column immediately in front of its coast. Still another is the proportionality criterion. The International Court of Justice in its decision in 1969, referred to a "reasonable degree of proportionality which a delimitation...ought to bring about between the extent of the continental shelf areas appertaining to the coastal state and the length of its coast measured in the general direction of the coastline". The 1969 decision also noted the general relief of the coasts of the parties as a factor to be taken into account of in a delimitation carried out in accordance with equitable principle.

Lastly, there are a number of 'socio-economic elements' which break down into three main parts. First, in a dispute over ownership of a marine area, there is the question of who got these first. Which country first learned to utilize the area, which first surveyed and charted it and harvested the resource? Second, what country now is the predominant researching state in the area? Which one carries out law enforcement and defence activities? Which maintains the aids to navigation? Third, which country is most dependent for its economic well-being on exploiting the resources of the coastal areas in question? These situations/circumstances have on occasion been used in supporting national position. Whether or not they are persuasive in a particular court of law is another matter.

There are, of course, other 'relative circumstances.' A major oil spill in a disputed area might be shown to have far greater negative effects on the coasts of one country than of another. A state, through its actions, may have inadvertently acquiesced in the other country's claim to the area in question. There may be old treaties relating to the allocation of marine territories which would be relevant to the controversy.

A final parameter of the delimitation process concerns technical questions about the exact positioning of a boundary line. Are parties to a delimitation process utilizing comparable charts? Are the low-water lines along the coasts compatible? And are the scales the same? More important are the map projections. A geodesic line, or a great circle route which approximates it, appears as a curved line on a Mercator's projection, when what is shown as a straight-line is, in reality, a rhumb line, not the shortest distance between two points. In the 1867 US-Russia Treaty defining the boundary between Alaska and Siberia, there is mention of straight lines joining fixed points. But the map the negotiators used has been lost. If the negotiators were thinking of a straight line as it appears on a Mercator's projection, the boundary would follow the rhumb line as shown on the map. If they were using a polyconic projection, a straight line on the map would be a great circle, and appear as a curved line on Mercator's projection. In the case of the Berring Sea, the difference between the rhumb and great circle lines is an area of nearly 15, 000 square nautical miles.

Calculating Limits

It had been decided at the Law of the Sea (LOS) conferences at Monaco in 1929 and at the Hague in 1930 that the territorial sea must be measured from low watermark at spring tide. But the 1958 Geneva Conference, later adopted the 'mean low water' as the baseline for the measurement of the territorial sea. On a simple, straight coast without any island or shoal, the delimitation of the territorial sea presents no problem. But most coasts are neither simple nor straight. They may be irregular in the extreme with offshore islands and submerged rocks.

The latter may be submerged only at high tide (drying rocks) or so low that waves break over them at all stages of the tide (awash). There may be offshore sandbanks called 'low-tide elevation', which are exposed at low tide but covered by water at high tide. These low-tide elevations slowly but continuously keep changing their shape and position. These low-tide elevation present the most difficult problem as to how the baseline or datum line is to be delimited/measured from the coast?

The 1958 Geneva Convention had decided that such low-tide elevations might only be used to extend the territorial sea if they fell within the territorial sea as measured from the coast. It was agreed upon that a state, with a claim of three-nautical-mile territorial sea, and a low-tide elevation two miles from its coast, might extend the territorial sea three miles from the low-tide elevation—a total of five miles. But, on the other hand, a state with a claim of three miles but a low-tide elevation at four miles from the coast, could not extend its territorial sea from the low-tide elevation simply because of the fact that the measurement from the low-tide elevation would have increased the breadth of the territorial sea to seven miles.

Bays and estuaries involve more problems in the measurement of the territorial sea. They are the most complex features occurring on the coast. If either is less than six miles across, assuming that the territorial seas have a width of three miles, then the whole is the part of the territorial sea. It also proposed that no bay wider than 10 miles should be claimed as inland water. In fact, a closing line drawn across the entrance to the bay or estuary would be taken as the baseline for the measurement of the territorial seas. This closing line is referred to as the 'line of closure'.

It now becomes necessary to distinguish between a bay and a mere coastal indentation. For this, the semicircle rule is applied. A straight-line is drawn between the natural entrance points of the indentation. "The water thus closed off forms a bay if its area is as large as, or longer than, that of a semicircle the diameter of which is equal in length to the closing line." If smaller, it is regarded merely as a coastal indentation, and the limit of the territorial sea is drawn parallel to the curvature of the coast. However, there are many bays which are much wider and, therefore, require much caution in the determination of the baseline vis-a-vis the territorial sea. It is stipulated in the LOS that the length of the baseline between the natural entrance points of the bay, particularly should not exceed 24 miles, which is twice the maximum claim to territorial waters.

When the mouth of the bay is more than 24 miles wider, its waters can be claimed only through the application of accepted methods of territorial waters delimitation. If the mouth of the bay is less than 24 miles in width, a semicircle is drawn with the closure line as its diameter. The area of the semicircle is now compared to the water of the bay behind the line of closure. If the bay has an area smaller than that of the semicircle based on its closure line, it cannot be cut off by such a line. If the water area of the bay is larger than that of the semicircle, it is indeed a part of the inland waters of the state in question.

There may be a complex situation when one or more islands are located in the mouth of the bay—then what procedure requires to be followed, if the width of the mouth is 40 miles and the islands make up 20 miles of that total? In that complex situation, the rule applies that the width of the water areas across the mouth must not exceed 24 miles, thus in the situation mentioned above, the bay may be inland water, subject to the usual calculation. There may be another situation in which the bay is more than 24 miles wide at its mouth, but which tapers inland. In that case, the coastal state may draw a closure line particularly where the width becomes just 24 miles.

Subsequent conventions of Law of the Sea (LOS) have taken a rather ambiguous stand with regard to the estuaries, which are geomorphologically, the drowned valleys of rivers. Normally, the rule of the line of closure is applied although the first LOS at Geneva did discuss the matter but without any compromise or solution on the part of the participants. However, the states have been found to be reluctant to apply the 24 miles rule to these water bodies. They may be so elongated that the semicircle across the mouth is larger than the enclosed waters. But, on the other hand, they may be more than 24 miles wide at their mouth. In both the cases the high seas appear to invade them.

In the absence of any defined procedure, the coastal states usually claim territorial waters on 'historic' grounds, having always asserted their sovereignty over the waters of the estuaries. The Varanger Fiord on the Norwegian coast is an example of a historic claim that was accepted by the former Soviet Union in the delimitation proceedings of 1957. Many of the wider bays and estuaries on the coast of the British Isles have also been claimed as 'historic waters', e.g., the Wash, the

Moray Firth, and Sligo (Donegal) Bay. The Nertherlands has long claimed the Wadden Sea between its northern string of islands and the Friesland-Grovengen mainland, whereas Indonesia claims all water separating its islands. There are some examples of coastal maritime powers claiming territorial waters on strategic grounds. The former Soviet Union had closed off Vladivastok Bay to all foreign vessels, claiming it to be a part of its internal water for strategic reasons. Nowhere, in the law of the sea, such claims of internal waters are the basis of 'historic ground' and 'strategic reasons' have any legal sanction and approval. It is felt that claims on such grounds would seal off substantial part of the high seas, jeopardizing the freedom of navigation.

Line of Median

The median-line rule is applied under certain exceptional conditions. Though the subsequent conferences on the law of the sea remained silent about the application of the median-line rule, nevertheless, the rule is applied under the bilateral agreement between the coastal states involved. The median-line, in case of the maritime boundary, is defined as a line every point of which is equidistant from the nearest points on the baselines from which the breadth of the territorial sea is measured.

A median-line is required under the following conditions: (i) when two adjacent coastal states, claiming the same width of territorial seas, still require a maritime boundary to connect their land boundary to their high-seas boundary; (ii) when two coastal states share a common estuary or a wide bay; (iii) when two coastal states may lie along a relatively straight coast, with their boundary reaching the coastline at right angles; and (iv) when adjacent coastal states feel interested in the territorial seas and the continental shelf beyond. In some other cases the maritime boundary may be oblique.

A number of examples of such situations occur in the (i) Swedish-Finnish boundary at the head of the Gulf of Bothnia; (ii) Israel-Jordan border on the Gulf of Aqaba; (iii) India-Bangladesh boundary at the head of the Bay of Bengal, at the mouth of the Ganga; (iv) Uruguay-Argentina boundary in the estuary of the Rio de la Plata, and (vi) India-Pakistan boundary in the estuary of the Indus. And there are some few hundred cases of such complex situations in the present world. Sometimes the islands lie so close together that the delimitation of their territorial seas shows an overlap/abut; at other situations coastal states face each other across a narrow channel. The Caribbean Sea is full of actual and potential situation of this kind.

The presence of smaller and longer islands in the bay or in the estuary often makes the median-line delimitation complicated, as is the case in the median-line delimitation of the Indo-Bangladesh maritime boundary at the head of the Bay of Bengal at the mouth of the Ganga as there are a number of offshore islands. The median-line delimitation can ward-off a long series of discussion and negotiation, particularly in cases related to the exploitable resources in the territorial seas and also on the continental shelf. As opposed to the median-line delimitation is the rule of the 'thalweg'. This resembles the navigable-channel method determining river boundaries but the thalweg of the river boundary often passes through the narrow channel, and the traffic, across it, has to pass through the international boundary. The thalweg in the estuary or in the bay is usually sufficiently wide so that the adjacent coastal states find no problem in the accommodation within their own section both incoming and outgoing ocean traffic.

Continental Shelf Complexities

Of all complexities with regard to the maritime boundary is that of the continental shelf which is geologically a part of the continent. It is composed of the same kinds of rocks and is likely to contain the same minerals as those of the continents. On an average, the continental shelf is about 100 miles wide but there is considerable regional variation from 5 to over 600 miles. The angle of slope of the shelf is so gentle that it is imperceptible. At a depth of about 100 fathoms (600 feet), the angle of slope increases, and the continental slope gives way to more steep continental slope. The continental shelf of the world covers about 7.6 per cent of the total area of the sea. It is with the Truman's declaration in 1945, extending the US jurisdiction over the natural resources of the subsoil and seabed of the continental shelf that it acquired political-legal significance in the international politics. Large number of Latin American coastal states followed suit. Conventions on the Law of the Sea (LOS) dealt with in detail, the problems arising out of the claims to the continental shelf.

Claims to the continental shelf undoubtedly, have produced unprecedented situations, whereby the boundaries of states represented by planes do not run vertically but nearly horizontal and parallel to the surface of a land-form. Thus, the maritime boundary consists of three planes: one vertical cutting the territorial sea off from the high seas; one nearly horizontal lying in fact, on top of the continental shelf; and another vertical plane continues downward from the seaward limit of this.

Apart from the obvious difficulties that have arisen over the relationship between the shelf-plane and the actual surface of the shelf (i.e., seabed), which has created a complex situation on the surface of the high seas which now require more and more modification in the nature of the claims. With the increasing knowledge about the resource potentiality of the continental shelf, the overlying waters will more and more become effectively 'occupied territory' of the coastal state. A large number of installations of permanent and semi-permanent nature are rapidly coming up, which in the near future may develop into 'continuous and intended occupation.' There is every possibility that the coastal states, adjoining extensive continental shelves, will demand that their entire boundary will be defined by the margin of the continental shelf.

Such a demand by the coastal state may lead to at least six major consequences: (i) the concept of a standard-width territorial sea requires to be abandoned; (ii) there would be conflicts over the allocation of 'shared' continental shelf; (iii) states without continental shelves may seek redress by claims to vast reaches of the oceans; (iv) coastal states may seek to establish, what is called 'conservation zones'; (v) poor and weak coastal states may grant authority to multinational corporations to search for resources and petroleum; and (vi) the core-periphery conflict may be widened further.

The Pacific coastal Latin American states have already claimed sovereignty over the continental shelf for a distance of 200 miles. Argentina claims sovereignty over a wide extent of the South Atlantic Ocean, including the British territories of Falklands. The Persian Gulf states claim sovereignty over the adjacent area of the continental shelf. India claims that its boundary should coincide with the outer margin of the continental shelf, both in the Arabian Sea and the Bay of Bengal. Sri Lanka has claimed conservation zone as far as 100 miles from its coast. Pakistan has proclaimed its intention of controlling all exploitative activity on the continental shelf adjoining its territory. Conflicts have arisen between India and Bangladesh over claims to the adjacent continental shelf. China claims substantial part of the South China Sea because the shelf below it is potentially rich in petroleum and natural gas.

The continental shelf of the North Sea has long remained a bone of contention between the adjoining states over the allocation of resources. A potential zone of conflict is that of the adjoining shelf of South-East Asia. It has developed into a zone of intense regional competition for the allocation of 'shared' continental shelf. Notwithstanding the creation of the Association of South-East Asian Nations (ASEAN), coastal states were involved in conflicts. Some of the sea nations of the ASEAN have allowed the US companies to carry out search for oil exploration.

A large number of states without potential continental shelves off their coasts claim hundreds of miles of territorial waters invading the high seas. There are certain pertinent questions with regard to the claims over the continental shelf.

1. Should a state be allowed to claim for itself all resources found below a depth of zero to 600 feet of water—just because the water ends there—for hundreds of miles of its coast, while another state cannot claim more than 12 miles of water or subsoil because that subsoil drops away precipitously?
2. How can the USA claim continental shelf resources 100 miles from the coastline while Ecuador and Peru cannot claim marine resources a similar distance away?

It is the technical ability of the coastal states to exploit the resources of the continental shelf rather than any uniquely defined boundary. As a result, the Continental Shelf Convention is now gradually being replaced by the 322-kilometre (200 miles) Exclusive Economic Zone which includes fisheries as well as the resources of the seabed. This new concept was agreed by the third UN Convention on the Law of the Sea in 1982.

Pending its replacement by the new UN Convention, the 1958 Geneva Convention on the Continental Shelf will continue to govern the status of it. Under the convention, the coastal state enjoys certain sovereign rights over the shelf but subject to these exceptions: the residual status of the waters above remain that of the high seas. In principle, therefore, freedom of navigation for foreign vessels continues to exist in those waters. Ships of all nationalities must, however, respect the

500-metre safety zones which the coastal states is entitled to establish around continental shelf installations and neither the installation nor their safety zone may be established where interference may be caused to the use of recognized sea lanes essential to international navigation.

If and when the new convention enters into force, the waters of the continental shelf up to 200 miles will overlap those of the exclusive economic zone. So far as the continental shelf is concerned, the Article 78 of the UN Convention simply provides that the rights of the coastal states over the continental shelf do not affect the legal status of the superjacent waters (which will be that of exclusive economic zone up to 200 miles and that of continental shelf beyond 300 miles, if the legal continental shelf extends that far). Article 78 goes on to say that the exercise of the coastal state's rights in the continental shelf must not infringe or result in any unjustifiable interference with navigation.

Origin of Exclusive Economic Zone

The Exclusive Economic Zone (EEZ) has its genesis in the 1945 Truman proclamation on the continental shelf. However, even before that, at the beginning of the twentieth century, there had emerged the idea of extending a coastal states' jurisdiction to encompass the resources lying in its adjacent waters. In fact, prior to UNCLOS III (1982), many states including the United States, exercised various rights, many of which are now encompassed by the concept of the EEZ in waters of the territorial sea. This change is so widespread that it is recognized by the American Law Institute as customary law, dictated that the concept of an EEZ be redefined at UNCLOS III.

Article 57 of the UN Convention on the LOS limits the EEZ to be further than 200 nautical miles from the baseline of the coastal states. This agreed upon limit has enormous implications in the vast amount of the ocean's surface of the world may be enclosed in such zones. It is conservatively estimated that 32 per cent of the ocean's surface, covering 28 million square miles, will be enclosed beyond coastal states' territorial waters.

It is obvious that the benefits of such enclosure will not be shared equally by the countries of the world. Some anomalous results will follow, including allowing some states to claim jurisdiction over areas of the ocean 10 to 100 times larger than their landmass. Micronesia, for instance, can close an area of about two million square nautical miles, which could produce an estimated revenue of three million dollars annually.

Another disproportionate impact involves the unequal distribution of natural resources throughout the zones. Typically, the greater living and mineral resources within 200 miles are disproportionately located within the zones of the economically developed states. It, therefore, seems logical that the treaty allows for a balancing of interests of the coastal states and other states in the EEZ.

The coastal states, according to Article 56 of the Convention, have 'sovereign rights' for the purposes of exploring and exploiting, conserving and managing the natural resources, living and non-living within the zone, including the seabed and the subsoil.

Also, coastal states have jurisdiction over artificial islands, marine scientific research and the protection and preservation of the marine environment within the EEZ. However, the coastal states shall have 'due regard' for the rights and duties of other states and these states must comply with the coastal states' rules and regulations in the zones.

Variable claims and counterclaims to the EEZ have created four distinct categories of States:

(i) The territorialist group, consisting of Latin American states including Brazil, Ecuador, El Salvador, Nicaragua, Peru, Uruguay and Argentina, and four African states, viz., Dahomey, Guinea, Somalia and Sierra Leone.

(ii) The heterogeneous coalition comprising of (a) coastal African states of the Organization of African Unity; (b) moderate Latin American states with Venezuela, Mexico, Colombia; (c) Asian states, viz., India and Sri Lanka; (d) coalition of industrially advanced coastal states, viz., Canada, Iceland, Norway, Australia and New Zealand; and (e) the Archipelagic states, viz., Indonesia, the Philippines, Fiji and Mauritius.

(iii) The coalition of the landlocked and geographically disadvantaged states. (iv) The coalition of the major maritime countries (core states).

Notwithstanding the above categories, the potential winners of the claims to the EEZ are those states with (a) long coastline and significant resources off their coasts; (b) with wide continental margins but the potential loser states are those (i) with short coastlines and narrow coastal margins; (ii) self-locked states without major oil deposits relatively near-shore; and (iii) landlocked states. Considerable number of maritime boundary disputes will arise in the next few years, particularly with regard to continental shelf and the EEZ.

The problem of defining the extent of territorial seas is not limited to the outer margins. Agreeing a landward baseline is often extremely difficult. Inland waters like Hudson Bay are normally counted as part of the land area, but not always; countries like Norway with strongly indented coastlines are usually deemed to have a baseline that joins the major promontories; in the case of island states such as Indonesia and the Philippines, straight boundaries are often adopted encompassing the whole of the archipelago.

In the majority of cases the solution has been to agree a median-line equidistant from the nearest point of the baseline of the coasts of the countries concerned, but such a simple solution has not always proved acceptable. An attempt at a comprehensive solution to such problems is proposed in the UNCLOS III Convention on the Law of the Sea.

The UNCLOS III proposed to establish a contiguous zone extending for 24 nautical miles beyond the limit of the territorial seas. The new concept of the 322 kilometre (200 mile) Exclusive Economic Zone which includes fisheries as well as the resources of the seabed, was first agreed by the United Nations Conference on the Law of the Sea in 1977, and the UNCLOS III in 1982-83 proposed to give it an international expression and recognition.

However, 22 states, including former Federal Republic of Germany, Italy, Japan, the UK and the US (mostly core states of the world systems/economy) decided against signing, mainly because they were dissatisfied with the proposed conditions governing seabed mining under the high seas. Nevertheless, it is expected that the Convention will be ratified by all parties eventually, providing a comprehensive framework for administering the oceans. It will suffice to note that the zone extends to 200 miles from territorial sea baselines that the problem of delimitation between neighbouring states is similar to that considered above in relation to the continental shelf, and that the EEZ has a naval jurisdiction status as compared with other offshore zones.

Prior to the introduction of the new EEZ concept, a common pattern had been followed in relation to the states of specialized functional zones beyond the territorial sea. The outer limit of the territorial sea has been as marking dividing line between a more landward area in which the fundamental principle of sovereignty had predominated, and exceptions to it were restrictively interpreted, and the more seaward functional zones in which the fundamental principle of the freedom of the high seas predominated but the coastal states enjoyed limited rights by way of exception. For example, the continental shelf and exclusive fishing zone were of this nature. In case of any doubt with regard to the outerlimit of the territorial sea, there would always be a presumption in favour of sovereignty of the coastal state. Seaward of this line, however, the presumption was in favour of the high seas.

The concept of EEZ departs from this pattern. It is a zone *sui generis* in which there are no presumptions one way or other, the rights of the coastal state and of other states being those actually specified in the UN Convention. This has, of course, been a matter of concern to the shipping community which feels that it has lost the preexisting safeguards favouring freedom of navigation.

8

Physical Features

The metaphor of society or of the state as an organism dates back at least to the French encylopaedists. Later Rousseau, in his *Discourse on Political Economy* (1775), compared the body politic to "an organized living body, resembling that of man", although he admitted the inaccuracy of the simile. Throughout the nineteenth century, however, theories of the state suffered increasing entanglement with biological analogies. Carl Ritter, in his *Comparative Geography,* developed, by analogy with physical organism, a cycle theory of state growth. Human cultures and political units were natural organic entities, each going through a natural cycle of birth, maturity, and death.

This idea of a developmental stage of a culture gave Ritter a new independent variable for more sophisticated analysis and theory building when coupled with the other variable, the physical environment, about which far more was known than in the times of earlier writers. Furthermore, armed with a clearer understanding of the role of nature that this developmental stage idea provided, Ritter went on to suggest that prediction was now possible.

At the global scale, cultures were seen in continental proportions, each continent representing an organ in the 'living world'. In this scheme, Ritter, as Montesquieu before him, saw Europe as naturally gaining precedence over all the other 'organs'. Its comparatively compact size and shape, its location in the temperate zone and its complexity of national entities equipped the continent for the most successful growth by immigration and cultural development, for Ritter believed that, given favourable environmental circumstances, 'strong cultures' had the ability to 'guide' their destinies. The notions about the workings of nature on the evolution of cultures, their implications for prediction and for global structure models, and their application in statecraft, were to lead, a generation later, to the theory of the organic state.

Auguste Comte, the French father of sociology, described society as a 'collective organism' with social institutions as its organs. "Foree", he wrote, "answers in sociology to tissue in biology: it is the cement of the social organism." Evolution or progress was characterized by increasing specialization of social institutions as organs.

General Notion

Charles Darwin's and Alfred Wallace's theories of biological evolution stimulated the elaboration of social organismic theories by Herbert Spencer in England and Albert Schaffle in Germany. Spencer introduced the phrase "survival of the fittest", translated the biological competition among the species into competition among human societies. This was known as 'Social Darwinism'. In his book *The Principles of Sociology* (1896), he emphasized the fact that the strong against the weak as a law of nature both among societies and among animals: "Tribes which are larger, or better organized, or both, conquer adjacent tribes and annex them...and as political evolution advances, it becomes a trait of the larger and stronger societies that they acquire appetites prompting them to subjugate and incorporate weaker societies...Thus, then, with social organisms as with individual organisms. It is through the struggle for existence, first, by appropriating one another's means of growth, and then by devouring one another, that there arise those great aggregates (of) high organization."

Schaffle in Germany advanced beyond Comte in his analysis of both the structure and the development of the social body, as had Spencer but Schaffle saw the family rather than the individual as the basic social unit. Beginning with the family, Schaffle posited an entelechy or life force of development to ever-higher social forms with increasing differentiation and integration of the social body. Comte had seen force as the cohesive element in the social organism: for Spencer society remained a mechanical puzzle, but Schaffle emphasized society's physical unity, the spiritual life and development, but he also noted the need for defence as an important element lending cohesion.

In his major work, *Structure and Life of the Social Body* (1875-78), Schaffle writes: "At the very summit of life on earth stands human society—the social body and its private and national institutions. Built up out of matter and impelled by forces of the organic and inorganic world, it is nevertheless a living body of peculiar kind. Human and civil society, a far higher structure than the societies of animals, is a purely spiritual result, an indivisible social life of organized individuals wrought out through the force of ideas and achievements of arts."

Organic Strata

Friedrich Ratzel is credited with having carried forward the tradition/heritage of his predecessor Carl Ritter with respect to the concept of the organic state.

Though he conceptualized the heritage of Carl Ritter, he drew upon the works of Herbert Spencer and Albert Schaffle to define his own use of the organismic analogy in his monumental *Politische Geographie* (1897), which is often described as the first book on modern political geography. He is rightly called the 'founder' of political geography and is certainly recognized as the "father of modern political geography". He gave a systematic treatment to this sub-discipline. He had a number of articles/papers to his credit, particularly in the field of political geography. These include: "People and Spaces" (1894), "The State and Its Land Geographically Considered"(1896), "The Territorial Growth of States: A Contribution to Scientific Political Geography" (1896), "Concerning Living Space" (1897), and "Living Space"(1901). Ratzel maintained that states are involved in an endless struggle for space.

All living organisms are in a fight for space, he believed, and the most powerful will have the largest spaces (reflection of Social Darwinism). States with high population density have a more valid claim to empty land than those with a low density. Thus, to become politically powerful, people should multiply themselves as rapidly as possible, and take over empty land. People of all states should develop a space conception or space consciousness, for the decay of every state is caused by a declining space conception.

For Ratzel an 'organism' was primarily a framework or structure cohesion occurred in the division of labour and specialization of functions. This was more abstract than a literal analogy with biological organisms. He used the word 'organism' largely because it was so widely used in his days, but he frequently warned against using the image too strictly. He applied alternative words, like, 'organized existence', 'structure', 'model', 'form' and even 'system'. There is much about Ratzel's use of the word 'organism' that actually approaches today's meaning of the world 'system'. Certainly Ratzel would have appreciated Anatal Rapaport's recent clarification that "the difference between 'living' and 'non-living' becomes obscure.

Systems that are 'living' in the common sense or biological sense of the word, share many features with systems that are not; and these common features derive from the way systems are organized. This suggests a generalization of the concept of 'organism' to the concept of 'organized system' Organized systems include organisms."

While using the organismic metaphor, Ratzel inquired what sort of organism that state might be. Both states and biological organisms are frameworks for the division of labour and specialization of functions, but the state is an extremely 'incomplete' organism because the members do not surrender their autonomy or individuality. Men retain their freedom to exchange roles in the state or even to emigrate. Also, while the goal of a biological system is to live and to reproduce, states and societies as systems must have public ends as goals.

Ratzel blended these ideas with Schaffle's interpretation of the societal organism, but he added a geographic dimension. Thus, for Ratzel, it is the state, rather than the society as for Schaffle, which becomes "one of the most magnificent manifestations of life on earth". The state has two complementary aspects: the 'organic' which is the land, and the 'spiritual' which is the society and the society's sentimental or econographities to the land. Both aspects evolve.

The organic aspect evolves as greater occupation of space leads to its organization, the differentiation of land usage, and exchange among regions. Transport routes are the veins and arteries of the state organism, and the landscape is transformed from natural to cultural. The state's spiritual aspect evolves with functional role differentiation in human society, and sentimental ties to the homeland represent an important element of continuity for the society. While Schaffle's discussion on societal development progressed from the family up to the nation, Ratzel's reached from the individual farmstead which was for him the most primitive state, up to the nation-state.

Important Theories

Based on the concepts of the organic state, Ratzel developed seven laws of the expansion of states:

The Size of the State Grows with its Culture: "The rationale of the first law contained Ratzel's interpretation of the political history of the world. He said: "States show a gradation of size in accordance with their historical age." He saw a close relationship between political expansion and economic and religious expansion. Ratzel stressed that organic states go through periods of youth, maturity and old age—the theme Ritter had promised for cultures. The cultural dispersals become the forerunners of the growth of the state which then utilizes the same routes and fills (i.e., occupies) the same areas."

The Growth of States Follows Other Manifestations of the Growth of Peoples, which must Necessarily Precede the Growth of States: "We have referred to diffusions which advance faster than the state, which precede and prepare the ground for it. Without political purpose of their own they come into the closest relationship with the life of states and do not stop at national boundaries. It is the principle of the mutual interest of the human race which binds nations together and which dominates them, yet without being involved in them. This mutual interest in life lies in the ideas and goods which tend together toward trade between peoples."

"Commerce and communication far precede politics which follows in their path and can never be sharply separated from them. Peaceful intercourse is the preliminary condition of the growth of the state. A primitive network of routes must have previously been formed. The ideas of uniting neighbouring areas must be preceded by apolitical information. If the state has entered its growth period, then it shares, with commerce, an interest in route connections. Every commercial route paves the way for political influences, every network of rivers provides a natural organization for state development, every federal allots commercial policy to the central government. Colonization usually follows the flag of commerce."

"The clear relationship between geographic discovery and the growth of state has long been recognized and is exhibited in the accomplishments of those who did both, such as Alexander, Caesar, Vasco da Gama....To the present, the greatest success of expansive politics has been prepared under the guardianship of geography. The best contemporary example is that of the Russians in Central Asia."

The Growth of the State Proceeds by the Annexation of Smaller Members into the Aggregate. At the Same Time, the Relationship of the Population to the Land becomes Continuously Closer: "From the mechanical integration of areas of the most varied sizes, populations and cultural levels, there arises, through proximity, communication and the intermixture of their inhabitants, an organic growth. The growth of states which does not transcend mere annexation makes only loose, easily sundered conglomerates which can only be temporarily held together by the will of one whose intellect realizes a larger conception of space."

The process of the amalgamation of regional districts similarly enjoins the closer relationship of the people with their land. The growth of the state over the surface of the earth can be compared to the down growth which leads to an attachment to the soil. It is more than a metaphor when one speaks of a people as taking root. The nation is an organic entity which, in the course of history, becomes increasingly attached to the land on which it exists. Just as an individual struggles with virgin land until he has forced it into cultivable fields, so too does a nation struggle with its land making it, through blood and sweat, increasingly its own until it is impossible to think of the two separately. Who can think of the French without France, or the Germans without Germany? Ceaser's greatness lay in the fact that he gave to the more stable body a definite, secure boundary as well as spatial expansion.

The Boundary is the Peripheral Organ of the State, the Bearer of its Growth as well as its Fortification, and takes Part in All of the Transformations of the Organism of the State: "Spatial growth manifests itself as a peripheral phenomenon in pushing outward the frontier which must be crossed by the carriers of growth. The closer these carriers live to the boundary, the more intimately do they share an interest in this process; and the larger the frontier the more pronouncedly peripheral will the growth be. A state which stretches out toward a desired district sends out at the same time growth nodes which exhibit more activity than does the rest of the periphery. This is desirable in the shape of the countries and in the distribution of their inhabitants and other power media.

The outcrops of Peshawar and Little Tibet, and those from Merv and Kokand permit immediate recognition of that which even their history does not show; that in their direction British India and Russia grow together, determined to envelope all the benefits of the lands which lie between them, just as Rome through conquering Gaul grew counter to the advancing Tentons."

In its Growth the State Strives toward the Envelopment of Politically Viable Positions: "In its growth and evaluation the state practices selection of geographical benefits in that it occupies the good location of a district before the poor. If its growth is related to the dispossession of other states, it victoriously captures the good areas and dispossessed continue in the bad.

Therefore, in the younger lands (colonies) whose entire history is known to us, the new political structures lie pronouncedly tiered along the sea, on the rivers and lakes, and in the fertile plains, while the older political forms are driven into the initially less accessible and less desired interior, into the steppes and deserts, the mountains and the swamps.... The envelopment of politically valuable locations is also expressed in the shape of the state...for since political growth consists of motion, or more the joining of countless movements, the state sees advantage in annexing those natural regions which favour movement. Thus, we see it striving to attain the coasts, moving along the rivers, and spreading out over the plains...the development of British dominion in India takes the form of an enclosing of the more powerful native states from the base of the more easily overpowered and weaker districts."

The First Stimuli to the Spatial Growth of States come to them from the out Side: Ratzel maintained that "as far as our knowledge of primitive states extends their growth has never advanced without foreign influence. The origin of such growth is colonization in the broader sense. Men from regions of larger spatial conceptions carry the idea of larger states into districts of lesser spatial concepts. The native who is aware only of his own state is always at a disadvantage to him. Geographic locations pointedly show how the larger states in areas of small statism have grown inward from the most accessible outer side, i.e., from the coasts or the edges of the deserts."

The General Tendency toward Territorial Annexation and Amalgamation is Transmitted from State to State and Continually Increases in Intensity: "With an increasing estimation of the political value, the land has become of increasingly greater influence as a measure of political power and as a spoil in the state struggles. As long as there is political competition, the weaker states attempt to equal the more powerful. Carried over to the land there arises from this a struggle for spatial annexation and amalgamation...From the smallest beginnings of growth to the giant states of the present...then...the same tendency toward the emulation of the large on the part of the small and toward the largest by those which are already large and wish to equal with the largest. This tendency is vital and, like a balance wheel, operates above variations and reverses to hold aloof the individual growth exertions...Naturally such emulation is not restricted to spatial size...And thus the drive toward the building of continually larger states continues throughout the entirety of history."

Let us examine what Ratzel meant by the word 'law'.

"But it is...primary goal of all sciences to find only that which the scientist calls a law? Geography in that case is not a science in the usual sense. Does not statistics deal with the same incalculability, with the many-faceted disposition of man, and which is, in this case, more expressive than strictly true? But the high probabilities which statistics derive from the comparison of many cases, what are they other than laws—we almost wish to say oscillating laws—in which strongly outstanding disturbances disappear in the totality... We too may attain such probabilities though we must of course also deal with further difficulty that history does not often offer us the many examples wanted for the statistical method" (*Anthropogeographie).*

Ratzel's laws of spatial growth, therefore, are not laws of 'necessity' at all. In speaking of the state as an 'organism', he concentrated his comparison on the relation of man in the collective sense, i.e., the state and the land. His thinking here is difficult to follow, but it is apparent that his comparison was not of the strict dog-eat-dog nature, so often attributed to him. He was referring to the relationship which develops between a people and the land which nourishes them, and the reciprocity which develops between them. Here again we must keep in the mind what it was that Ratzel meant by the term 'law'. He referred to tendencies rather than absolutes, as is clear from the following passages of his book, *Anthropogeographie:*

"There arises a political organization of the land through which the state becomes an organism in that a fixed portion of the surface of the earth enters into such a degree that the properties of the states are a combination of those of the people and of the land." "The state is not an organism merely because it forms a connection between a living population and the fixed earth, but rather because this connection is so strengthened by reciprocity that the two become one and can no longer be thought of as separate. The state with highly developed organism among animals and plants in which the members must make the greatest sacrifices of individuality in the service of the whole, measured by this standard reflects that the 'state' of man is an exceptionally undeveloped organism, for its members preserve an independence which no longer occurs even in the lower plants and animals."

"The comparison of the state with highly developed organisms is unfruitful. And if so many scientific attempts to approach the state as an organism have borne so little fruit, it is primarily because of the limitation of such consideration to the analogy between an aggregate of men and the structure of an organic creature." These are hardly the words of one who sees the biological necessity of growing by securing essential missing organs, if necessary, by force. Thus, it is obvious that Ratzel (a zoologist by training) was only too well aware of the limits of the scientific biological analogy. He, then, viewed the state as a living organism (an organic entity increasingly attached to the land on which it lives) with no rigid limits, the key to successful growth being in the development of its civilization, as he attempted to prove with an analysis of the growth of past empires. He carried forward Ritter's notion of evolution from youth to maturity with a correlation between growing old age and diminishing size.

Ratzel included the idea of 'community' as a prerequisite for political union and for the development of nationalism with the diffusion of ideas. The process of integration and disintegration, he felt, formed a major portion of historical movements, depicted geographically as an interchange between larger and smaller political regions. He also recognized the relationship between cultural levels and areal scale of territoriality.

Space and Competition

At the end of the nineteenth century, Ratzel was witnessing what has been termed as the "closure of the world". Men were coming to occupy all of the inhabitable world while revolutionary developments in transport and communications tied all regions of the world more closely. With population still increasing, Ratzel believed that each generation would feel more keenly a scarcity of land. Each nation needed room for expansion, which he termed 'lebensraum' (room to live). The term can be traced back to Goethe, but Ratzel's famous essay "Der Lebensraum" dedicated to Albert Schaffle, forever linked Ratzel's name most closely with this term. Much of what he had to say about 'lebensraum' is in fact vague, but his idea was frequently misconstrued and extrapolated by later researchers.

He saw space filled through the expansion of originally isolated settlements. Smaller political units at lower stages of development were naturally subsumed in ever larger political units with increasingly advanced concepts and capabilities of spatial organization. Individual farmsteads in the American West, for instance, were subsumed in the larger society and state. While Spencer had attributed this process to 'appetites' of the longer and more powerful units, Ratzel saw it as happening quite naturally, although not necessarily without conflict. Some small units might not want to be subsumed, and larger units might compete for space. The acquisition or reservation of land for future generation was an important responsibility of any state.

Conflicts among units competing for space was inevitable, but Ratzel never went on to say which states should triumph, or what a state should do to survive. At the time he was writing, the far-flung British Empire was envy of Germany;

and Ratzel's writing is not free of 'Anglophobic rhetoric'. Apart from recommendation that Germany maintain naval parity with England and hold onto African colonies, however, Ratzel made no specific suggestions about how a state could or should win any eventual struggle for 'lebensraum'. He presented an explanation for aggression, but not a rationale or recommendation for aggression.

Critical Assessment

Pounds (1963: 1972) makes a critical evaluation of the concept of the organic state, especially in the light of the contemporary cold war. He maintains: " The organic view of the state has coloured and perhaps has also done much to create the fundamental hostility between the communist and the non-communist worlds, which has been the dominant feature of the past quarter of a century...The struggle between the Soviet Union and the United States in such countries as Turkey, Afghanistan, Pakistan or those of South-east Asia does, in fact, bear a superficial resemblance to that which the Social Darwinists assume to exist between states."

"The organic view permits of prediction only if one can accept the view that all states must expand territorially if they are to survive as separate states. Any such policy as that of coexistence must be ruled out: biological species do not undertake to refrain from their struggle for survival, it is claimed; states should not do so either. Any government that accepted the organic theory of the state, as that of the Nazi Germany appears to have done, must necessarily pursue a policy of aggression.

The Glib assertion of Neville Chamberlain, after the Munich settlement had surrendered a major part of Czechoslovakia to Germany, that this meant 'peace in our time' should have been recognized for the foolishness that it was. There could be no lasting peace with a state which believed that expansion and aggression were a condition of existence...yet the organic theory of the state is fallacious. Geographical space and society that occupies it, necessarily attains some element of organization, but in no proper sense does it take on the character of organism. It has no life or will other than that of the aggregate of its citizens, and its future is what their descendants make it. The idea that a state must grow if it is to live and that there is virtue in mere size is not only erroneous but also dangerous."

The concept of Ratzel of the organic state, and also, the concept of 'lebensraum' provided the material base for the development of geopolitik in the latter period. Ratzel had few immediate followers. Two of his closest disciples were :

(a) the American Ellen Sample who studied under him and returned to the United States to undertake anthropogeograpahical studies, and

(b) the Swedish political scientist Rudolf Kjellen of the Universities of Goteberg and Uppasala, who is often identified as the first and major post-Ratzelian disciple to have carried forward the Ratzelian model of the organic state and the concept of 'lebensaum' further towards Social Drawinism and sought to make them more applied.

Rudolf Kjellan's Contribution : Rudolf Kjellan wrote most of his important works in Swedish and whose contribution to political geography has been judged principally on the basis of one major book translated into German by M. Langfeldt.

Kjellen elaborated on the Ratzelian model of the organic state by adding the dimension of moral and intellectual capacities or by introducing aspects of quality of the population, and the nation whose aggregate constitutes the body of the state. In addition to moral capacities, there was, in Kjellen's view, the 'will', the cumulative psychological force of the state. In assessing power, he reasoned that "the great power (grossmacht) is a concept which is not mathematical but dynamic, not ethnic or cultural but psychological...The great power is above all, a will richly endowed with power means." Or, in other words, Kjellen was particularly interested in the process involved in the transformation of a territory from a natural area to a cultural-political region. He viewed this process as a perpetual interchange among 'country, people and government.' This process of human occupation of a region gave it, in causal sequence, continuity, solidarity, interaction, loyalty and nationality; that is, the creation of a nation with what he called a 'geopolitical instinct'.

He regarded states not so much as legal bodies but as competing powers. He saw the state in a condition of constant competition with other states, larger states would extend their power over smaller ones, and ultimately the world would have only a few very large and extremely powerful states. In his most important theoretical work, *The State as a Form of Life,* Kjellen argued: "Vitally strong states with a limited area of sovereignty are dominated by the categorical imperative to enlarge their areas by colonization, union with other states, or conquests of different types...it is not the raw instinct of conquest, but the natural and necessary trend towards expansion as a means of self-preservation." Kristof remarked that "Kjellen sanctioned as natural the instinct of men and nations to satisfy their desires at another's expense."

Kjellen believed that a state must fulfil three requirements to be a world power. First, states must have 'spaciousness', that is, they must be located within a large contiguous land area. Secondly, states must have 'internal cohesion' in order to be powerful. He said that Britain would have never become a world power because it lacked both spaciousness and, because of its Irish and Welsh dissidents. Thirdly, Kjellen said that great states must have 'freedom of movement'. Russia had spaciousness and internal cohesion but, he observed, it would never be a world power because it lacked access to warm-water ports. However, he wrote that the Germans had the right to natural growth because of their 'psychological will'. He, however, chided Germany for not being a great state because it lacked all the three of his requirements.

In analyzing the state, Kjellen made the following distinctions: *Geopolitik* or geography and the state; *Demopolitik* or population and the state; *Oekopolitik, or economic resources and the state; Sociopolitik,* or social structure of the state; and *Kratopolitik* or government of the state. It is noteworthy that he placed the study of geography and the state first and the study of government of the state last. He believed that the power of the maritime empires would pass to the command of the land empires (obvious reflection of the Geographical Pivot-Heartland model of Mackinder), who would control the seas. Kjellen foresaw the emergence of a few giant states in the world, with Germany as the great power in Europe, Africa and Western Asia.

Kjellen defined geopolitik as "the theory of the states as a geographic organism or phenomenon in space, i.e., as land, territory, area or most especially, as country", or "the study of the strategies of political organisms in space".

General Notion of Geopolitik

After the death of Rudolf Kjellen in 1922, Karl Haushofer became the leading exponent of Geopolitik. In fact, Haushafer borrowed the word 'geopolitik' which Kjellen had introduced in his book *Der Staat als Lebensform.* It is not difficult to understand how the ideas of Kjellen, coupled with the Ratzelian tradition, caught the imagination of many geographers in inter-war Germany. The group under the leadership of Karl Haushofer, formed the Institute fur Geopolitik, attached to the University of Munich, which dominated German geography from 1922 to 1945. Haushofer started editing the journal *Zeit-*

schrift fur Geopolitik in 1924. This was, certainly, an epoch-making development, particularly in the contemporary heritage of political geography.

Basic to geopolitik's ideas were Ratzel's organic state concept, its refinements by Kjellen, and the Geographical Pivot-Heartland model of Mackinder which sought to illustrate that any political power that would effectively occupy and control the Heartland (Eurasian core) could by definition achieve a dominant world position.

"To Haushofer and his group the ideas of Ratzel and Kjellen on the one hand, and of Mackinder on the other, formed a symbiosis which seemed to have special relevance to Germany's post-World War I position vis-a-vis geopolitik. Ratzel-Kjellen tradition sought to justify the need of populous states for living space (lebensraum), and hence the growth of some states, such as Germany, at the expense of less viril neighbouring states—"Germany's expansion is a natural phenomenon. The country is over-populated. It must expand." Mackinder's Heartland thesis seemed to indicate to the German geopoliticians the necessity for a detente or even an alliance between Germany and the chief occupant of the Heartland—Soviet Russia.

Development of Geopolitik

Geopolitik owed much of its development to the journal *Zeitschrift fur Geopolitik,* and the Institute fur Geopolitik. The 'Institute' eventually attached to itself able geographers and workers in cognate fields. These men developed a considerable amount of 'geopolitikal' theory and began to elaborate a vast array of data to be filed in the 'Strategic Index' of the 'Institute, "The basic, incontestable truth is that Haushofer, directly in some instances, indirectly in others, coordinated, integrated, and rationalized the whole field of comparative geography for the uses of the Fuehrer. As time went by, the 'Institute' became more and more an instrument for national policy and a tool of the state—for which purposes it received a government subsidy in funds and patronage. Geography, particularly war geography, became a national preoccupation which influenced and moulded public opinion in post-war Germany from elementary school to university seminar, from street corner and book-store to factory, club, beer hall and dinner table."

The geopoliticians of Munich started with an organismic concept of the state, as well as with the practiced techniques of cartography and geographic research. Added to these were their 'Weltanschauung', or world perspective, and a motivation springing from the national pathology that characterized Germany between the world wars. They defined their subject as "the science of the earth relationship to political developments". Karl Haushofer asserted that the word 'politik' is not preceded by the prefix 'geo' by accident. The prefix relates politics to the earth (ge=earth in Greek). The geopoliticians of Munich also attempted to apply the principles and methods of geopolitics to "branch' sciences such as psychology, medicine, and jurisprudence.

'Geopolitikal' concepts in Germany centered round a number of subjects. The idea of organic state, living space (lebensraum) and the organic frontier received considerable attention in the contemporary German literatures. Behind the idea of political power of the state was its location with reference to a specific concept of the distribution of land masses and ocean spaces. The expression of the power of the state in wartime involved the study of Wehr-Geopolitik or war geopolitik, for the 'aim of power war'. At the Institute fur Geopolitik, the strength and weaknesses of a certain area (raum) were compared with the location (lage) of the region and the nature of the boundaries (grenzen).

Geopolitik, then, according to Zeitschrift fur Geopolitik, "...is the science which deals with the dependence of political events upon the soil (i.e., physical setting). It is based upon the broad foundations of geography, especially political geography. Geopolitik aims to furnish the weapons for political action, and the principles for guidance in political life...Geopolitik must become the geographical conscience of the state."

In other words, the study of geopolitik should suggest the future course of political action and, like the still, small voice of conscience, keep reminding politicians of what they should do in the best interests of their state. Yel geopolitik was something more than strategy because it helped to formulate the objective of policy as well as being the means by which that objective might ultimately be reached.

It is indeed a fact that the German geopolitik cannot be fully understood without assessing the career of Karl Haushofer, reference of whom has already been made above. Haushofer was a career officer in German army and in 1908 he was sent to Japan. It was during his stay in Japan, that he learnt lot of things which had a deep impact on his perception, specially that which concerned the space-power relationship. He was very much impressed with the contemporary monolithic political system in Japan and wished if it could be established in Germany. It was in Japan itself, he understood/realized that space (raum) was also a factor in power. He shared the Japanese claim that their people required more space and that the mere fact that the population was growing fast in itself justified them in taking it. "Confronted by the more numerous Chinese, Russians and Americans, Japan could find security only in large population and, of course, in the possession of land to support this increase.

Planned conquest in Korea and China was to satisfy at once the political, territorial and economic needs of Japan." We have seen above that Karl Haushofer read with much enthusiasm, the Geographical Pivot-Heartland thesis of Mackinder, and those of the writings of Ratzel and Kjellen. In fact, the contemporary literatures of Mackinder, Ratzel, and Kjellen helped him to build theoretical and conceptual frameworks, while his stay in Japan helped him to acquire "empirically experience of the reality of the 'lebensraum' which gave observation statements on peculiar privilege over theoretical ones which guaranteed their generality" through Kjellen-introduced word 'geopolitik'.

Haushofer's *Die Geopolitik des Paziftschen Ozeans: Studien uber die Wechselbeziehunger Zwischen geographic and Geschichte* (Geopolitics of the Pacific Ocean: Studies on Relationship between Geography and History), first published in 1924, was his monumental work. His other important works were: (i) *Geographische Grundzuge Auswartiger Politik,* published in Suddeutsche Monatshefte, in 1926-27; and (ii) *Weltpolitik von Heute,* published in 1936. He prepared a world model of three pan-regions based upon Germany, Japan and the USA.

This was an interesting geographical organization in that it involved functional regions around each core state cross-cutting environmental resource regions which straddle the earth latitudinally. As political economy concepts they involved three regions with potential for economic self-sufficiency or autarchy. If fully developed such a model would have consisted of three separate world systems each with its own core—Europe, Japan and Anglo-America—and periphery—Africa and India, East and Southeast Asia and Latin America respectively. Such a world model of co-existence was no better or worse than other models and may not be too far from the mark with the current device of the USA dominance of the world economy.

Nature of Geopolitik

To Haushofer and his followers, the science of geopolitik was dynamic, that the political conditions could never long remain stable, if only because the 'laws' of the state organism prescribed growth and the growth of one such entity could be only at the expense of others. "Every nation is primarily concerned with the task of maintaining itself in a hostile environment, and since its very existence depends on the possession of an adequate space, the preservation and protection of that space must determine all its policies. If the space has grown too small, it has to be expanded." He spoke of the mathematical ratio of people to the land; presumably each state was the judge of its own needs.

Expansion, according to Haushofer, was a categorical imperative in the Kantian sense for all nations. It should be "the guiding principle of small and handicapped states which seek to attain or to regain a place in the world politics". He further said that "great powers, unencumbered in their movements, can set themselves important long range objectives—small states, on the other hand, find obstacles in their way wherever they turn".

Geopolitik had the power to satisfy the urge of great powers to expand at the expense of the weak. The power politics of the Grossmachte were thus held to derive their sanction from a kind of natural law. The concept of 'lebensraum' (living space), thus, became the *raison d'etre* of Haushofer's geopolitik, in particular the 'lebensraum' of Germany itself. This, Haushofer argued repeatedly, was inadequate for Germany's need, and it could be extended only at the expense of the Slav countries to the east.

"Alliance with Russia would not only permit this ambition to be realized but would also establish German influence in that pivot area, in which, following Mackinder, he placed the fulcrum of world power." Haushofer made use of various cartographic representations to convey his desires to the high-ranking Nazi official, Rudolf Hess, who openly shared his (Haushofer's) views. The objectives of policy which led to the series of crises from 1934 to 1939 were fully in tune with Haushofer's views.

Perhaps the most concise explanation, with regard to the nature of geopolitik, came not from Karl Haushofer himself but from his disciple, Otto Maull, who elaborated it with a definition of Geopolitik as, "Geopolitik concerns itself with the state, not as a static concept, but as a living being. Geopolitik investigates the states primarily in relation to its environment—its space—and attempts to solve all problems resulting from spatial relationships.

Geopolitik is concerned with the spatial requirements of a state while political geography examines only its space conditions. In putting geography at the service of space-conscious politics, geopolitik devotes itself to questions of the future. Are the space needs of a state met? If not, how can they be brought into accord with geographical conditions? In what direction should any change be made? The extent to which these questions are answered determines a state's national and economic structure and influences its foreign relations... Geopolitik is a discipline that weighs and evaluates a given situation and by its conclusion seeks to guide practical politics."

It can be said with certainty that the Haushofer-Otto Maull tradition of geopolitik justified the *raison d'etre* of Nazi Germany. It was the 'state idea' to which the whole Germanic nation enthusiastically adhered. There is no doubt that the rise to power of National Socialism gave geopolitik much more prestige than it had previously enjoyed in Germany. Geopolitik—the Ratzel-Mackinder-Kjellen-Haushofer-Otto Maull tradition—suffered a sudden premature death with the fall of the Third Reich at the end of the second world war in 1945.

However, many of its associated nations, such as the application of political-geographical concepts, have survived in the general field of 'geopolitics' or applied political geography. As Ladis Kristof has put it: "Geopolitics should cover all the fields parallel to and intermediate between political science and political geography. It should embrace the investigation of the objective impact of natural environment...on politics. Real geopolitics resembles political geography."

Kristof has sought to distinguish between them: "The only difference between political geography and geopolitics is in emphasis—in the focus of attention. Political geography tends to focus...on the geographical phenomena; it gives a political interpretation and studies the political aspects of geographic phenomena. Geopolitics tends to focus on the political phenomena and attempts to give a geographical interpretation and study the geographical aspects of these phenomena."

Revival of Geopolitics in Post-world War Period : Revival of geopolitics in the post-world war period may be attributed to a number of factors, such as those of the cold war, break-up of the colonial empires, followed by the emergence of large number of nation-states, and the more complex world than before. These were the post-war developments which provided the necessary impetus to the revival of geopolitics, notwithstanding the demise of the German geopolitik with the collapse of the Nazi Germany.

However,the post-war geopolitics has increasingly come to be synonymous with the word 'imperialism'. Here a distinction must be made between geopolitics and imperialism: while the former is concerned with rivalry between major powers (core and rising semi-periphery states) and the later as domination by strong states (in the core) of weak states (in the periphery). Politically, geopolitics describes a rivalry relation whereas imperialism describes a dominance relation. Spatially, they are currently reflected in 'east-west' and 'north-south' spatial patterns respectively.

The interesting question for political geography is the relation between the two concepts in their politics and spatial structure. In world-systems analysis geopolitics is about rivalry (currently East vs. West) in the core for domination of the periphery by imperialism (currently North over South).

However, with the collapse of the Soviet Union, the *raison d'etre* of the cold war has disappeared, but with the unification of Germany and the economic supremacy of Japan at the expense of the USA and Western Europe, geopolitics received fresh impetus. In the search for an explanation of the global geopolitical order, three complementary approaches may be identified from a myriad of essentially empirical researches.

Current Approach

(a) The power relations perspective focuses on the regionalization and hierarchical character of states within the global order by examining a polity's ability to influence or change the behaviour of others in a desired direction. Political scientists have considered such power relations in terms of global equilibrium, by formulating post-war international relations as a model of bipolarity in the late 1940s and 1950s, loose bipolarity in the late 1950s and 1960s, and the multipolar world of 1970s, 1980s and 1990s. The recent emergence of additional global powers, such as Japan, China, Western Europe and Germany to that of the USA, and the fall of the Soviet system, together with the rise of primarily Third World regional powers, appeared to have led the world system as moving from its previous integrative stage to one of unfolding, hierarchical integration.

Yet, the second order or regional powers cannot be assumed to be moving towards a neatly ordered global hierarchy, in which location and power determine their scope and influence, although Cohen sees this as desirable from the vantage of the US foreign policy. Besides the thorny issue of whether the balance of power has prevented global catastrophe, it would seem that geopolitical equilibrium has preserved a hierarchy of powerful states at the expense of the small and weak. These issues apart, Cohen's model of regional shelter belts is useful. Based on geography's traditional concern with the cultural realm, regions such as Southeast Asia and the Middle East are considered as inherently unstable, both as a consequence of their global geostrategic importance and as a result of their regional characteristics.

(b) The second approach examines the legitimizing ideology of the state, or, in other words, the basis upon which the state is founded and organized and through which it justifies its territorial actions, both domestically and globally. This philosophical and moral conception of the state's destiny or mission can be traced back to the internal development of both superpowers, diametrically opposite to each other: USA and the erstwhile USSR, and host of other countries (late 1980s and early 1990s have witnessed the fall of communism in East Europe, followed by the collapse of the Soviet Union. Nevertheless, China has now emerged as the forerunner of the global communist movement).

For the USA, the expanding frontier was based on a continental mission of a society of democratic pathfinders destined to conquer and civilize the wilderness. Similar arguments were used in the nineteenth century to justify the US expansion and influence throughout its hemisphere—the Monroe doctrine. With its emergence as superpower, geopolitical and economic interests became inseparable from its moral mission as a leader of liberty and freedom; and thus as the container of communism. The sense of uniqueness also legitimized the continental spread of Tsarist Russia, on the pretext that the Empire had a mission to spread the Russian orthodox religion. With the 1917 Russian Revolution, this mission changed but in seeing itself as the prototype of the new society of the future, the sense of uniqueness remained. The success of Soviet Socialism was premised on the truth of Marxism-Leninism and in the belief of a society moving forward with the forces of history. Besides legitimizing intervention in the Third World, the erstwhile USSR's view of itself and also as 'primus inter paves' within the post-war socialist camp meant it could justify military intervention whenever socialism was found to be threatened, for example, intervention in Hungary and Czechoslovakia, respectively. However, Gorbachav's Soviet Union refrained itself from intervening in its East European satellite states when peoples there revolted against socialism, and pulled down the socialist regimes in their respective countries, making the communist ideology irrelevant to the state.

(c) The political economy approach focuses on who gets what, where and how. Here, the underlying assumption is that geopolitics cannot be understood fully without considering the dynamics of the global economy, be it in terms of East-West or North-South relations. Wallerstein (1984) has taken this proposition further by considering the links between the processes of capital accumulation, resource competition and foreign policy as a part of a singular and interdependent global system in which capitalism determines the character and hierarchical configuration of states. Such a world system has thrust the USA in particular into a pivotal geostrategic and economic role, while the former Soviet Union played a less significant part in world affairs because of its limited economic capabilities, in spite of being a superpower. Japan is now challenging the global economic role of the USA largely because of its 'sustained' capacities and abilities.

By focusing at the international scale and by taking economic forces as determining relations between states, there is, however, a tendency to relegate politics and cultural processes at the state level as causally related to economic forces, when in fact they can play an important and independent part in influencing the nature of international relations.

We shall now discuss two important geopolitical models which have especial relevance to the understanding of the global political systems, and the 'rivalry-dominance relation' in historical perspectives.

Long Cycle Model of Modelski : Modelski is concerned with the global political system in which the extra-European arena is central to the argument and the emphasis is upon a system of states rather than the ordering of individual states. Modelski's model is also of greater interest because it was developed specifically to counter Waller-stein's approach. To him, Wallerstein has undervalued the importance of political process in the original statement of his world economy framework. Modelski's global system begins about 1500 A.D. and then proceeds to develop in a cyclical manner. He sought to create a new type of cycle of just over a hundred years in length—and we are now experiencing the fifth such cycles.

Each cycle is associated with a world power which is defined as a state and engages in over half the 'order-keeping' function of the global political systems. Four such world powers have existed, viz., Portugal, Netherlands, Britain and the USA. These have dominated 'their centuries'—Portugal the sixteenth, Netherlands the seventeenth, Britain the eighteenth and the nineteenth, and the USA in the twentieth. Britain is unique in dominating two global cycles.

In each case the rise and fall of the world power is indicated through definite steps. A cycle starts with a weak global organizational structure of political competition which degenerates into global war. Such wars have wide geographical range and have global pay offs—the winner is able to order the resulting political systems. This phase ends with a legitimizing treaty which formally sets up the new world order centered on the new world power. No world power can maintain its control for ever and so a decline phase sets in. Initially, the world order becomes bi-polar and then multi-polar before the system becomes weakly organized again, is ripe for the rise of a new world power, and the cycle starts again.

Modelski's international political system is global from its inception. This is not just a matter of geographical definition: it relates to how the role of Portugal is interpreted. For Modelski, by taking over the trading network in the Indian Ocean, the Portuguese became the centre of a global system and hence a world power. In contrast, Wallerstein places most of the Portuguese activity in the external arena outside the world economy; Spanish American colonization is far more important in that it creates a new periphery. For Modelski, Spain only operated on the fringes of his system and never developed a 'world outlook'. Here is the crux of difference between the two approaches since the notion of a world outlook in the global sense is totally unnecessary for Wallerstein. His world system was originally a European world economy and only became global in scope around 1900 A.D.

The mechanism for change in his long cycles of global politics is twofold. First, there is what is called "the urge to make global order". Once the possibilities of a global order became known, an innate will for power has become expressed as an urge to shape world order. Only a few people may have such a world outlook but they respond to the inarticulated needs of the many. Second, the nature of international politics as a system means that structures run down and have to be reconstructed. All systems suffer a loss of order and survive by cyclical development. Describes a particular expression of this general process. It is on the basis of these two mechanisms that change has occurred in Modelski's global system.

Modelski, in the beginning of his model, has sought to point out that the global political system must be functionally distinguished from the world economy, particularly in terms of the mechanisms for change. However, his assertion does not reflect that he sought to underestimate the importance of economic processes—his politics is about who gets what in the world systems. In the world systems approach, it is a classic example of the poverty of disciplines.

The state system and the economic system are integral part of a single process of development incorporated in the concept of the world economy. There are not two logics but one. The world economy could not operate except within the political framework provided by a competitive state system. It is a necessary definition of a capitalist world economy. The implication of this is that mechanisms of change are not economic but both. Instead of Modeleski's model, there is the need of a political economy model for bringing history into 'geopolitics'.

Hegemony Rivalry Model

In the world systems approach, there is a system of cycles which represents a far superior mechanism of change than in Modelski's politics. Political mechanisms are an integral part of the overall process of restructuring the world economy that occurs within these cycles. In the following model this political element has been sought to be illustrated.

Political activity has always been an integral part of the world economy. State policies are important processes in the changes observed in the world economy. Since they are neither independent processes nor mere reflections of economic necessities (economism), it follows that there is some choice available. If there were no choices, there would be no need for public institutions such as the state. Public agencies have the role of distorting market forces in favour of those private groups controlling the agency. There has never been a 'pure' world economy even in periods when free trade has dominated. The power of a public agency and hence its ability to organize the market depends upon the strength of its backers and their material resources. Strong states may promote a 'free market' while less strong states may favour explicit distortion of the market through protectionism, for instance. In this way states can act as a medium through which a first set of production processes, upon which the world economy operates, are translated into a second set of distribution processes and patterns. Since these intermediate processes tend to favour the already strong, it follows that political activity will often increase the economic polarization of the market (i.e., helping the core at the expense of the periphery).

The power of a state to organize the market to its own ends is not just a property of that state's resources. The fact that we are dealing with a world economy and not a world empire (that there is a multiplicity of states) means relative positions are more important than measures of absolute power. These state positions are relative not only to other states, however, but also to the gross availability of material resources within the world economy. The cyclical nature of material growth means that opportunities for operating various state policies vary systematically over time. This is not just a matter of different economic environments being suited to alternative state strategies. At any particular conjunction specially successful policies can only work for a limited number of agencies. Quite simply every successful state eliminates opportunities for other states. There will always be constraints in terms of the total world resources available for redistribution via state activities. Given the 'correct' policies, it is not possible for all semi-periphery states and the periphery to become core-like. Although this is not a zero-sum game in a static sense since the available production is always changing in a cyclical fashion, nevertheless, we do have here a sort of 'dynamic zero-sum game'.

If the state activity is an integral part of the operation of the world economy we should be able to model it within the temporal and spatial frameworks. Just such a model has been proposed by Wallerstein and his associates (Research Working Group, 1979). They postulate political activity centers occurring over a time-period covering two Kondratieff waves. This activity centres round brief hegemonic interludes when one state dominates the world economy. Hegemony builds up in three stages. Initially, the state gains primacy in production efficiency over its rivals. This enables its merchants to develop a commercial supremacy which finally leads into financial dominance. When productive commercial and financial activities of one state are more efficient than all rivals, that state's hegemony occurs. This favoured situation is brief, however, as rivals emulate the technical achievements and the hegemonic state's lead over its rivals declines first in production, then commerce and finally finance.

Hegemonic Power : Rise and Fall : The rise and fall of hegemonic power relates to 'paired-Kondratieffs' as follows. If we start with a first growth phase, A-l, we find 'geopolitical rivalry' as core states complete for succession to leadership. On hindsight, however, we can see new technological advances are concentrated in one country so that increased productive efficiency gives this state a long term advantage. A-l is associated with the stage of 'ascending hegemony'. In B-l overall decline of the world economy leaves less opportunities for expansion but the ascending power now derives commercial supremacy and is able to protect its interests relative to its rivals. By this stage it is clear which state is to be new hegemonic power. B-l is associated with stage of 'hegemonic victory'. With renewed growth of the world economy, we reach A-2 the stage of 'hegemonic maturity. By this time the financial centre of the world-economy has moved to the hegemonic state which is now supreme in production, commerce and finance (i.e., 'true' hegemony). Since the hegemonic power can successfully compete with all its rivals, it now favours 'opening' the world economy. These are periods of free trade. Finally, 'declining hegemony' occurs during B-2 when productive efficiency is no longer sufficient to dominate rivals. This is a period of acute competition and new powers try to obtain a larger share of a declining market. There are periods of protectionism and formal imperialism as each rival attempts to preserve its own portion of the periphery.

According to Wallerstein's research group, the four Kondratieff cycles from the industrial revolution can be interpreted as two 'paired Kondiatieff. The first pair covering the nineteenth century, corresponds to the rise and fall of British hegemony and the second pair describes a similar sequence of events for USA in the twentieth century. There is no need to consider this table in great detail except to note how several episodes neatly fit the model.

In terms of our discussion of state involvement in the operation of the world economy, phase A-2 and B-2 are particularly important. In the A-2 the hegemonic power imposes open trade on the system to reap the rewards of its own efficiency. In the mid-nineteenth century, Britain proclaimed 'free trade' backed up by gunboats and a century later a new world policeman, this time with aircraft carriers, was going through the whole process of liberalizing trade once again. These policies certainly contributed to the massive growth of the world economy in the A-2 phase and were imposed through a mixture of negotiation, bargaining and bullying. Options for non-hegemonic power were highly constrained and they largely went along with hegemonic leadership.

All these changes with the onset of the B-2 phase, however, as productive efficiency spread, economic leadership deserts the hegemonic power. These are the key periods because of the opportunities available for other core and semi-periphery states that declining hegemony provides. The imposition of free trade is no longer taken for granted as various states workout new strategies for the new circumstances. In the late nineteenth century, Britain entered the depression as hegemonic power and came out behind Germany and USA in terms of productive efficiency. The B-2 phases are clearly fundamental periods of restructuring in the world economy in which geopolitical processes play an important role. We are currently living through just such a phase.

What about the period before 1790? Wallerstein and his associates extend their model back to the very beginning of the world economy. This involves identifying paired-Kondratieffs in the sixteenth, seventeenth and eighteenth centuries. The first two coincide with Hapsburg and Dutch hegemony respectively but the third pair covers a period of English-French rivalry with no clear hegemonic victory. However, the use of Kondratieff cycles for this early period must remain highly tentative. As we have previously indicated we prefer to stay on much firmer ground by employing the early world economy logistic curve. The A-phase involved the establishment of the world economy and the geopolitical rivalry was largely concerned with preventing it being transformed into a world empire. With the consolidation in the B-phase we come to hegemonic episode based upon Dutch efficiencies in production, commerce and finance. At this time (C.1650) we find mercantilist policies being devised by England and France to upset the liberal trade regime imposed by the Dutch. This seventeenth century sequence of events has many similarities with those for the paired Kondratieffs in the nineteenth and twentieth centuries. This account for the attempt by Wallerstein and associates to apply their model to this period. However, the Dutch hegemony is very short and much less decisive than the later British and American versions.

The whole of the long B-phase is probably best interpreted generally as a competitive period finally centered upon English-French rivalry but with important contributions from Holland, Prussia, Sweden and Northeast America. The rivalry was finally settled by the advantage adhering to England in the wake of the industrial revolution. In all meantime, the general lack of hegemonic control meant that groups in Sweden and Prussia and even Northeast America could carve out important niches for themselves in the world economy. The first two cases illustrate early examples of the use of powerful state machineries to control part of the world economy for private ends. In the American, case semi-peripheral status was achieved without control of a state machinery although the eventual need for such a machinery led to the war of independence and subsequently the Federal Constitution.

Resultant Developments

The similarities, between the American position in the twentieth century and in Britain in the nineteenth century, are very real in the dynamic model of hegemony and rivalry, and that of Modelski's emphasis. But there are important differences as well. So far the British hegemony went relatively unchallenged in the mid-nineteenth century but the US hegemony, particularly, since the end of the Second World War remained challenged politically and militarily by the Soviet Union, till the collapse of its system in 1992. But, for the remaining part of the decade, the US hegemony appears to go unchallenged particularly in the political and military arenas, and there is no equivalent rivalry to its hegemony. But, there is every likelihood of the fall in the US hegemony in the current century. The declining US hegemony may be attributed to its fast increasing trade deficits. The declining hegemony of USA in the coming years is ushering in a new era of rivalry which can be termed 'west versus west'.

The replacement of the American hegemony by a new era of rivalry is now generally acknowledged; and that can be referred to a 'multi-polarity' Five 'poles' are usually identified, viz., the USA, Western Europe, Germany (unified Germany has replaced USSR since the later's disintegration), Japan and China. But the really interesting question is what follows. In the paired-Kondratieff model, one of these rivals should emerge to form a new hegemony. This will be based not on military prowess but on economic efficiency, initially in production. The USSR has already ceased to exist. Germany and China are yet to achieve economic efficiency to the extent of global dimension, so they are ruled out to become potential rivals to the US hegemony. However, a historical reversal in the direction of uneven development has occurred with the massive penetration of the American market by Western European and especially Japanese manufactured products. As Japanese economic supremacy moves from production to commerce and finally to finance, we should be looking for changes in Japanese trade policy from their special branch of 'inscrutable' mercantilism to a new liberalism. In this scenario, the twenty-first century will be the 'Japanese century'.

Global geopolitics in the late 1980s and early 1990s witnessed abrupt fall of the socialism, or what Wallerstein terms 'anti-systemic regimes' in East Europe and the Soviet Union, which had significant impact on the revolutionary movement elsewhere. Anti-systemic regimes in East European states collapsed first, but it is important to observe that the Soviet Union did not intervene to protect the socialist regimes there, as it had done earlier in Hungary and Czechoslovakia. Gorbachav's Soviet Union adopted the policy of 'openness' and 'non-intervention'. The fall of the anti-systemic regimes in East Europe was followed by the fall of the Berlin Wall by the enthusiastic Germans on either sides and which finally led to the unification of Germany. The unification of Germany was followed by the breakup/collapse of the Soviet system, which brought down its status as a 'superpower' making it unmatchable to the US hegemony. Yugoslavia and Czechosolvakia also suffered territorial splits. The fall of the anti-systemic regimes in the Soviet Union and the other East European countries may be attributed to their failure to achieve economic susceptibility at par with the world economy. However, it is only in China (one of the five rising poles) that the anti-systemic regime still continues to exist but in no way the Chinese regime poses a serious challenge to the US hegemony—politically, militarily and economically.

The fall of the anti-systemic Soviet Union and its satellite states has wider ramifications on the contemporary geopolitics:

(i) disappearance of 'the Armageddon scenario', which, since the end of the second world war, had developed as a result of the stockpiling of nuclear weapons by the superpowers—USA and USSR;

(ii) anti-systemic organizations like the Warsaw Pact and COMECON have been abandoned;

(iii) the former Soviet Republics have formed the Commonwealth of Independent States, which is negotiating with West European states and the US, for their membership in the European Union and the NATO;

(iv) the fall of the anti-systemic regimes and the subsequent emergence of Germany seem to have changed the balance of power in the continent;

(v) emerging European Union is destined to play a key role in the world economy that is to challenge the US/ Japanese hegemony in the near future, and also to contain the rise of Germany; and

(vi) the fall of the anti-systemic regime has made the non-alignment movement among the peripheral states highly irrelevant to the contemporary global geopolitics.

In the current rivalry phase, it is only the traditional inter-state competition which is therefore important, but the great amount of internal unrest in the wake of social security cut-backs in the core and direct wage reduction elsewhere. Urban riots in the core, economic and political crises in the semi-periphery, for instance, in Poland, Iran, Nigeria, Brazil to mention one country from each of the four continents, and impoverishment within peripheral countries are equally important as the rise of Japan.

It is not only the economies of the world economy that is being restructured, the polities are also being gradually transformed. The scenario constitutes the world systems approach to the traditional crisis of capitalism and the fall of the anti-systemic regimes. For Wallerstein the process will take another 100-150 years to complete but one cannot simply envisage what the new system will look into any more than the European upper class of 1450 A.D. could predict the capitalist world economy. We can, however, suggest that any attainment of a more equalitarian system will depend on geopolitics giving way to imperialism as the key relation in the future dynamics of the world economy on the locus of change moves 'south'.

A New Dimension of Global Change and Geopolitics: A New Dimension Global change and geopolitics are both concepts that mean different things to different people. The enlightenment that scientific discourse is supposed to bring suffers from such ambiguities and misunderstandings. They should be, therefore, spelled out, versions of concepts should be compared and their implications clarified.

Some people are convinced that comprehensive shifts are taking place in the natural geosphere and the biosphere of the globe. Man's role has catastrophically changed the face of the earth. The debate concerning these global changes is about their social and economic impacts in different parts of the globe and remedial actions. The sustainability of the natural environment and thereby of human development is the issue. Global changes, to others, refer primarily to the radical increases in human mobility; the mobility of human themselves, their goods and bads (e.g., weaponry). Their symbols (e.g., money) and the impact of these increased volatilities for social life and the major formal tenets of social order; the units of territorially organized state system. This global change has implication of human development in various corners of the globe. Global change is, therefore, either change in overall physical nature of the world or change in the capacity and realization of human movement.

Geopolitics has also divergent meanings. In the older definitions of the term, states are assumed to be dependent on their physical features as far as their foreign policy and international relations are concerned. Their site and situation account, in fact, for their position in international affairs or leave them at best with a very limited number of options. This knowledge is in the possession of a limited set of professional students. They apply these views to concrete cares. In more recent years this notion of physical features as a determining factor for the conduct of the foreign policy has been increasingly challenged by academic geographers. At the same time, the meaning of geopolitics has shifted in academic discourse. Henceforth, it is not so much considered as a theory of inhibiting factors known by professionals, but as an object of study : the geographical perceptions of foreign policy makers. They are no longer supposed to be driven by external forces, but they are supposed to share geographically specific world views, political maps of the world that indicate friends and foes, strengths and weaknesses, and that supply, thereby, arguments for and against certain foreign policy options. Geopolitics should be concerned with the study of the ways in which such maps are constructed and how they function.

Global Change Versions

Two versions each of global change and geopolitics require to be dealt with here. The versions (1) and (2) of each concept can be mutually related. The four ensuing combinations demonstrate four different ways to discuss issues of international and foreign policy in the context of worldwide changes that are now taking place. In this way, the differential vulnerabilities of the state system come to the fore as well as its indispensibility to deal with the various challenges that 'global change' imply. Finally, the question how global change (1) and (2) and geopolitics (1) and (2) are internally related will be discussed.

How does global change (1) affect geopolitics (1)? This question deals with the changes in the natural environment and their impact on the natural factors that according to this viewpoint conditions foreign policy. We have to look at this in a longer time perspective. If several of the scenarios concerned with the changes in the geosphere/biosphere came to pass, this would seriously affect the resource bases of states and their rankings. Even fairly small upward changes in the general sea level will seriously threaten urban life, major infrastructure and important agricultural areas in many coastal lands. Changing climatic conditions dramatically alter agricultural potential in many places possibly in different directions. The ensuing changes in the rankings of composite power indices of countries and the changes in mutual trade potentials result in changes in situations of countries vis-a-vis each other. Reorderings of site qualities and situation characteristics would imply shifts in the patterns of harmony and conflict in international relations. If foreign policy is set by physical conditions, as geopolitics (1) holds, global change (2) will seriously change parameters of international relations in the long run.

How does global change (1) affect geopolitics (2)? How does the possibly impending degradation of the natural/ physical environment at the global scale affect the mindset of foreign policy makers? Global change (1) is relatively new problem. It has in its last two decades seriously entered the domain of public policy. Through international organizations as UNEP, an interpretive framework has quickly been disseminated to policy makers. At the same time an important 'green lobby' has kept the global problem and its local specifications before the public eye.

Nevertheless, global change (1) is still driven by debate among professionals who still dispute some of the basic issues (e.g., is global warming really taking place?). As a consequence, it looks as if the issue of global change has entered the perception of foreign policy makers. Its salience is very much dependent upon the rest of the foreign policy agenda in a specific country as well as the connectedness of foreign policy makers to the professional world of scientists who conduct the debate on these issues. The relative power of the local emanation of the 'green lobby' is also important in this connection to the extent that global change (1) plays a role in the setting of foreign policy, it will affect perceptions of who are friends and foes in the world and accordingly may transform existing coalitions.

How does global change (2) conditions geopolitics (1)? In other words, how does the increasing mobility of humans and their tangible exchanges have an impact on the physical attributes of countries that provide the setting of foreign policy?

First of all, the built environment and thus the resource base of countries change as a result of increased mobility. This mobility needs an important physical infrastructure. Its parts are assets that greatly affect the qualities of a country's site and situation. Ports and airports, motor roads and rail roads that are connected with international networks deeply influence the internal quality and international position of a country. Austria's and Switzerland's natural landscapes are now as important as their international connections. The competition between airports concerning their relative centrality in the networks of international corrections is nervously watched by governments who consider this to be major determining factor of their country's international position.

The question in this instance is to what extent such factors do indeed directly affect a country's international position. Secondly, as humans move across international borders and the international exchange patterns of tangible goods shift relentlessly and become more dense, two facts follow : resource bases that include a population and the capital goods encompassed by their built environments become more dependent on international movement and they may consequently change more rapidly. To the extent that physical characteristics indeed determine foreign policy, there is ample reason to expect incisive consequences of heightened international mobility. Ranks change more rapidly, interdependence grows.

How does global change (2) relate to geopolitics (2)? International human mobility increases and trade goods grow, but the exchange of intangibles (money, images) has caught up and surpassed these trends. World financial markets interconnect virtually all places on the globe; much economic activity is thus regulated from the few foremost financial centres that set the tone for the pattern of money flows in the world at large. An extensive set of symbols and images is shared or at least understood by large proportions of the world population. A large part of that repertoire is manufactured in a few places that have a large impact on perception. The vicinity of the rest of the world is, although intangible, deeply felt by large proportions of the world population. Foreign policy makers are confronted with a multitude of foreign signs and exchange of symbols that result in more tangible consequences, e.g., of money flows. These come across international borders and have an immediate impact on domestic politics. Thus, the traditional divide between foreign and domestic policy making has largely disappeared. Foreign policy makers are also far more immediately and more often confronted with foreign events than was the case in earlier periods. The construction of the geopolitical world maps that underlie the making of foreign policy has in consequence become more contested by the continuous flow of new information and by the wider domestic arena in which foreign policy has to be debated.

So far we have considered the different versions of global change and of geopolitics as if they were unconnected. In fact, they are not. The processes that affect the biosphere and the geosphere and that threaten to undermine existing equilibria in those two spheres, are driven by the ever expanding human use of the globe's natural assets. Population growth, non-renewable resource, intensive socio-economic development account for these processes. Mobility, particularly of persons and of goods, is a very important part of that kind of development.

Thus, global changes (1) and (2) emanate partly from the same source and are thus related. The theory of geopolitics that assumes an immediate effect of the physical environment on a country's international position, i.e., geopolitics (1), has for a long time been discredited for the conduct of foreign policy as it seems to underestimate the room for political manoeuvre and has a tendency to overestimate the military security arguments in the setting of foreign policy.

Geopolitics (2) has so far remained a suggestive research programme that is in danger of over-interpretation on the basis of a shortage of empirical data. It is evident that the construction of geopolitical world maps is an important and inevitable part of foreign policy making, the more so as the signals that result from global change (2) increase in number and become more difficult to interpret. It looks, though, as if a new emphasis on global change (1) (a deteriorating natural environment) necessitates a new look at the physical environment in which states operate. Thus, maps constructed as part of geopolitics (2) will take more of their contents from modernized versions of geopolitics (1). The resource bases of the different fragments of the territorial state system have as a consequence of global change (1) won a new sense of urgency. In addition, the resource bases of those different fragments turn out to be partially shared.

9

Nation and State

Concept and Evolution of Territoriality

Territoriality is an attempt by an individual or group to influence or establish control over a clearly demarcated territory which is made distinctive and considered at least partially exclusive by its inhabitants or those who define its bounds. Most works emphasize territoriality as a fundamental human need, based on identity, defence and stimulation.

The concept of territoriality owes much of its origin to Robert Andrey's book, *The Territorial Imperative* (1966). "A territory", Andrey writes, "is an area of space, whether of water or earth or air, which an animal or group of animals defends as an exclusive preserve. The word is also used to describe the inward compulsion in animate beings to possess and defend such a space. A territorial species of animals, therefore, is one in which all males, and sometimes females too, bear an inherent drive to gain and defend an exclusive property. We may be permitted to wonder if in all territorial species there does not exist, more profound than simple learning, some universal recognition of territorial rights." With regard to man whether he is such a territorial species, Andrey remarks: "Man...is as much a territorial animal as is a mocking bird singing in the clear California night."

The implications of such a statement, obviously, are enormously far-reaching. If it is essentially correct, then man's sense of territoriality as an instinctive drive is a greater determinant of his politico-territorial adjustment and organization than what he has learned through social and cultural evolution de Blij (1972) remarks that " if we define the concept of territoriality as a pattern of behaviour whereby living space is fragmented into more or less well-defined territories whose limits are viewed as inviolable by their occupants, it becomes clear that political geographers have for some time recognized this phenomenon.

Any such territories, after all, will acquire certain particular characteristics—Gottmann called it iconography. The Ratzel-Kjellen-Haushofer school of geopoliticians were in the process of defining a form of territoriality when they conceptualized the state as an organic being. Hartshorne and Jones argued that the state be viewed as an entity whose characteristics could be linked, ultimately, to the behaviour of the individuals constituting it."

"Combining the concepts of territoriality and dominance behaviour, perhaps we may extrapolate to the superimposed boundaries that evolved from truce lines or colonial imposition, to the racial compartmentalization of South Africa (surely an especially good example of dominance behaviour), to the competition for Northern Ireland (where the social order that arose out of dominance behaviour is being challenged) and to the ghettoization of US cities. In so doing we assume that territoriality in man does exist more or less. Andrey proposed and that dominance behaviour prevails—a sort of generally accepted superior-inferior, dominant-subordinate hierarchy that operates vertically and is expressed spatially."

One idea about which there is still much uncertainty lies in the roots of territoriality. If indeed, territoriality is a phenomenon of human behaviour, is it instinctive or has it been acquired and modified by learning—through cultural revolution? In other words, is it less an 'imperative' than Andrey suggested? And the concomitant, human aggression—is it similarly universal and is it genetic in its origins or is it neither? E.W. Soja, reacting to the views of Andrey and others, points out in 1971 that "only when human society began to increase significantly in scale and complexity did territoriality reassert itself as a powerful behavioural and organizational phenomenon.

But this was a cultural and symbolic territoriality, not the primitive territoriality of the primates and other animals...Thus, although cultural territoriality fundamentally begins with the origins of the cultured primate man, it achieves a central prominence in society only with the emergence of the state. And it probably attains its fullest flowering as an organizational basis for society in the formally structured, rigidly compartmentalized, and fiercely defended nation-state of the present day."

What Soja sought to spell out was that territoriality as it was expressed by our complex societies was not the same phenomenon as that which commanded our distant ancestors—or our animal contemporaries. Nor, according to some anthropologists, is man the 'naked ape' driven by savagery and killer instincts.

A. Alland in 1972 argues forcefully that aggressiveness and territoriality are not universal human imperatives at all, in fact, he goes so far as to say that territoriality is born with and nurtured by culture. Viewing some primitive peoples like those still living a hunting-and-gathering existence, Alland observes that these have the weakest of territorial imperatives; supposedly they are the ones that should have the strongest instinct of this sort, if territoriality is indeed a biological urge. He seems to have not been so convinced either about the vigour with which nation-states are inevitably created and defended, he views draft-laws, anthem-singing, sledge-reciting, and flag-waving an evidence that states do not find defenders so easy to come by.

R.D. Sack is credited with having brought the concept of territoriality within the purview of political geography. He has conceptualized the theory of territoriality which seeks to emphasize territorial behaviour in human beings as a conscious decision-making strategy. Whereas Robert Andrey insists that the universal requirements of identity, security and stimulation are met by instinctive territorial behaviour in species as different as robins and human beings.

General Notion of Spatial Relations

Sack, in his papers, entitled, "Territorial Bones of Power" (1981), and "Human Territoriality" (1983), seeks to identify two basic forms of spatial relations:

(a) action by contact; and

(b) territoriality.

Most of geographical analysis has been concerned with action by contact, both direct and indirect, as in all spatial interaction theories dealing with flows of people, commodities and ideas. The key concept of this spatial relation is distance decay. In contrast, there is a spatial relation of territoriality based on the key concept of territory. This is the attempt to affect, influence or control actions by enforcing control over a specific geographical area. This behaviour is territoriality and the area is the territory.

Territorial Indoctrination

However, it cannot be proved that group values toward the shared space are instinctual. There is abundant evidence that territorial attitudes may be cultural. It is usually emphasized that individual perception of space varies cross-culturally; similar variation might be observed among culture groups.

Territorial attitudes are often fostered in what might be called 'territorial indoctrination', the use of specially territorial iconography to reinforce integration. This introduction may take place through the schools or in the folk culture. The school system of each state concentrates on national geography and each child receives a distinct map image of the state.

Geography in the history class can affect a national territorial image. "American children, for example, hear the phrase Manifest Destiny, and see a map of continual territorial expansion." Such geography lessons carry important political overtones, and may foster a political climate for territorial claims or boundary disputes. National anthem often sing of the land as a sacred trust.

Territorial symbols in iconography are not restricted to nation-states, but are common among subunits of sovereign states. Most of the states in the Indian Union have their own distinctive cultural-linguistic symbols expressing a common territorial past and destiny. The same is true in case of all the fifty states in the United States.

The importance of territorial iconography stems largely from the territory's assumed durability, for men long to be a part of something stable and permanent. Men, institutions, beliefs, and laws change but the land undergoes transformation perceptible only to geologists studying millenia of evolution. Abraham Lincoln listed people, laws and territory as the three ingredients of a nation, and then added, "the territory is the only part which is of certain durability."

The land may, of course, be invaded and lost, divided, or even possibly reduced to a pile of radioactive dust, but still it seems less perishable than anything else.

Functions and Approaches of Territoriality

Sack identifies four distinct functions of territoriality and their different combinations produce nine different strategies.

1. The most important function of territoriality, as implied in its definition, is the enforcing control over access to the territory. Territory explicitly involves an 'in-group'; and an 'out-group'. In inter-state relations this is termed as citizenship. All states control flows across their territorial boundaries on the basis of distinguishing their own 'citizens' and 'foreigners'.
2. A much more subtle function of territoriality is its role in reifying power. Unlike physical features such as rivers and roads, power is an intangible concept until it impinges on behaviour. In the modern world one way in which power is made explicit and real is through its direct link to the territory of the modern state. It is for this reason that much political action from defining boundaries to siting capital cities has been considered 'neutrals'.
3. Territoriality has a vital function in displacing attention from the social relation of dominance. Dominance becomes transformed into neutral enforcement of the law of the land, so that the social relation is displaced to a territorial rule. All modern states rely upon most citizens obeying their laws as a member of a territorial community, the nation-state.
4. Territoriality acts as a container of events. The territory becomes an object to which other attributes are assigned. In peace this will involve all the territory being subject

to particular outside pressures such an International Monetary Fund's demands for welfare cuts to pay all debts. The IMF will assess a country as a container of a set of potential resources. In wartime the territory is a container of enemy personnel. In the twentieth century this has led to civilian populations being targets of air-raids. The application of this concept in the nuclear age leads to genocide or even speciecide as we have seen.

Different combinations of four functions can be used to produce nine types of strategies:

1. The territorial definition of social relations is a combination of A, B, and C. The state's territory is the container for defining citizenship which may be used to provide preferential access to resources in the territory. This is reified through mystical justification by nationalism. The ultimate losers of this strategy are stateless refugees.
2. An efficient span of control relates to enforcing the containment of events. As a state increases in size its boundary extends and control may become more difficult. One of the explanations for the 'fall' of all world empires is that they over-extended their span of control. In the world economy, the Spanish and Portuguese empires seem to have become class.
3. A three-tiered spatial structure clearly emerges that can be identified in the new division of labour for agricultural production: 'free' wage labour developing in the Northwest European core, partially free 'share cropping' arrangements in the Mediterranean semi-periphery, and in the periphery, two different forms of coerced labour-slavery in the New World and the so-called 'second feudalism' in Eastern Europe. Despite massive changes in the world economy since this time these three essential features have remained and are

just as important today as they were in the seventeenth century.

4. Mismatch of territory and process will occur in some of the boundary drawing exercises described earlier. This combines all four functions and is perhaps best illustrated in the definitions of African colonial boundaries and their continued use by the independent states. Territory is the basis of a new control attempting to reify power with a new nationalism by displacing traditional ethnic social relations.
5. Territory appears as an end rather than a means in the modern state system through nationalism. The territorial function of displacing social relations is vital here as 'class differences' are overwhelmed by national consensus.
6. Territoriality in involving control of access can become a strategy of generating inequality. The best example of this is the process of social imperialism whereby welfare provisions for all citizens of a core state have multiplied the inequalities between core and periphery.
7. Divide and rule is in many ways the basic strategy underlying the world economy's need for an inter-state system. By dividing up opposition into separate territories in which power is reified, capital interests have been able to contain revolts to specific territories and avoid a worldwide revolution.
8. Social conflict is obscured where enforcing control and displacing social conflict are combined. The result is a situation where conflict occurs between territories in place of the original generating social conflict. An example of this is the classical Marxist interpretation of the First World War where conflict between industrial and banking groups culminated in a war of nations.

9. Obscuration by geographical scale again involves A and C but this time is concerned with a double use of territory. This is the allocation of political power to a scale of operation at which it is relatively powerless. Political power is limited to the scale of ideology, sovereign territories, while the scale of reality, of basic change, is the world economy.

10. Territorial secession is, in many ways, the reverse of the functions described. They are turned and used to generate partition of the territory. In this sense it is related to strategy 3 but concentrates more on the breaking of the reification of power of territorial state. Palestine, Cyprus, Northern Ireland, Lebanon, Korea, Vietnam, and of course, Germany, are or have been examples of such successful strategies on one side or the other. Commenting on Sack's theory, Taylor (1985) observes that "the first importance of..is that it is a beginning in defining new theories of conscious decision-making which exercise once and for all dangerous natural analogies in political geography. Second, and more important, is the fact that we are provided with a framework that allows us to go beyond Herz's simple security definition of the territorial state and expand on Gottmann's addition of opportunity. Using just Herz's concept we are led to argue that technological developments have made the territorial state obsolete, with this more sophisticated theory we can see that there is much more to the state than a shell. Other uses of territoriality will ensure the survival of this phenomenon as long as the world economy survives."

To conclude, we can say that it is important to envisage human territoriality as conditioned primarily by cultural norms and values which vary in structure and function from society to society, from one time period to another, and in accordance with the scale of social activity. At the lowest and most personalized level, there is the bubble of personal space immediately surrounding the individual which in many cultural contexts is considered by the individual as inviolable space. At the societal level, territoriality becomes a means of regulating social interaction and a focus and symbol for group membership and identity, ranging from the scale of urban gangs and their turfs, through patterns of territorial regionalism, to the compartmentalization of the world into a system of states.

Evolution of the State

A state is traditionally defined as an area of land (or land and water) with relatively well-defined, internationally recognized boundaries. Within this territory resides a people with an independent political identity and loyalty which is usually referred to as nationalism and territoriality. In other words, a state is an area organized politically in an effective manner by an indigenous, or resident, people with a government in effective control of the area.

The word 'state' comes from the Latin 'status' and its medieval usage related to either the 'state' or condition of a ruler or the 'state' of the realm. The idea of a public power separate from ruler and ruled which is the supreme political authority in a given territory does not occur at this medieval period or earlier periods. The modern concept develops from this medieval usage in the sixteenth century first in France and then in England. It is argued that these two countries provided early examples of the properties that make up the modern state—a centralized regime based on a bureaucracy operating within well-established boundaries. By the end of the sixteenth century the modern concept of the state was well established in these two countries and modern political analysis focusing on the nature of the state can be said to begin from this time onwards.

The notion of sovereignty assumes the existence of the state. The territoriality only operates through the medium of the state. This is a two-way relationship. At the simplest level the state is defined by its possession of sovereignty. This tends to distinguish it from all other forms of human organization. Sovereignty amounts to nothing less than supreme coercive power within a territory—the state "gives order to all and receives orders from none" inside its recognized boundaries. Invasion by a foreign power or internal insurgency aiming at creating a new state are both violations of a state's sovereignty. If not defeated the state no longer has a monopoly of coercion in its territory and faces extinction. The disintegration of the Soviet Union, the division of Yugoslavia and the division of Czechoslovakia are examples of extinction by internal violation of sovereignty.

General Notion of State

As regards the idea of the state, Bergman (1975) observes: "Throughout much of Western Europe the institutional framework of the Christian Church survived the collapse of the Western Roman Empire. Church organization had been based on the empire system with the Pope in Rome and with the bishops in major cities holding exclusive territorial responsibility. The Church pattern survived the retreat of the imperial authority because bishops cannot abandon their dioceses; the diocesan pattern remained intact under the barbarians. Thus, the Church administration remained to teach the barbarian tribes two important legal principles. One was territoriality, the principle of 'dominum'. Many of the tribes had wandered in 'regnum' political association for hundred of years, united only in allegiance to powerful leaders. Under the influence of the Church they gradually evolved territorial rule. The Merovingians (5th-8th centuries), for example, called themselves Kings of the Franks but the later Capetians (10th-14th centuries) were already Kings of Franks."

The second principle taught by the Church was 'entail', succession through only one inheritor of the king's lands and wealth. Barbarian custom had divided rights and possessions among sons, splitting up realms, and often causing civil wars. The Church sought to insure kingdoms' integrity upon the deaths of individual kings. The barbarian tribes' assimilation of the principles of dominum and entail stabilized political organization and laid the foundation for the development of principalities and territorial states.

During the centuries the barbarians were converted to Christianity, the hope remained that either the pope or else a purely secular ruler could reestablish one universal Christian empire. The Church allied with the powerful Frankish kingdom, and on Christmas Day in 800 A.D. Pope Leo III proclaimed the Frankish king Charlemagne protector and, it was hoped, restorer of Christendom in a new Holy Roman Empire. This art defined a new relationship between Church and State power. The emperor ruled over earthly matters by divine right and Church sanction. As the sole repository of earthly sovereignty, he 'was' the State. The Church remained sovereign and protector over men's souls; its concerns were of eternal life, and it retained exclusive authority to interpret Christian practice. There was no salvation outside the Church. The Church monopolized religious authority just as sovereign monopolized political authority.

"This separation of function and responsibility between Church and State lent each stability. The Church legitimized the sovereign, and the sovereign protected the Church. With the development of the numerous independent European kingdoms outside the Holy Roman Empire, the Church reached similar philosophical accommodation with each of them."

"The sovereign exercised political power, but the Church was a far more implicative institution than was political authority. The sovereign (i.e., the State) demanded only obedience, neither claiming nor seeking additional adherence or allegiance. The Church, on the other hand, claimed belief and personal commitment. In earthly matters men were variously ranked and privileged, but they were all equal in the Church. The people did not have a stake in political affairs, there was no political community. The only community was the Church, the 'community of Christ'. European sovereigns could play musical chair with Europe's thrones and redraw the political map at will. Louis XIV quite correctly remarked, "I am the State". So, the earlier idea of the state was necessarily linked up with the religion, more specifically with the Christianity. But the idea of the State changed over time."

However, the basic idea of the modern state seems to have first appeared at the same time as the emergence of the world economy itself. Foregoing discussion is a testimony of it.

To de Blij (1972), "The emergence of modern Europe may be said to date from the second half of the fifteenth century. Western Europe's monarchies began to represent something more than mere authority, increasingly they became centres of an emerging national consciousness, pride and trade. At the same time, the trend toward fragmentation, which had dominated the feudal period, was reversed as various monarchies, through marriages, alliance or both, combined to promote territorial unity. Feudal privileges were being recaptured by the central authority, and there was progress in the parliamentary representation of the general population. Renewed interest was shown in Greek and Roman philosophies of government and administration. Europe was ready for change."

Change did come to Europe, and in many forms. The emerging states engaged in intense commercial competition and mercantilism was viewed as the correct kind of economic policy to serve the general interest of all. The search for precious metals, the standard of wealth, sent the ships of several countries traversing the oceans to lands that lay open for discovery and appropriation. Kings and noblemen sent many of those ships on their way, but in the growing cities a new class of influential men was on the rise—the merchants. Their capital strength increased by leaps and bounds, and before long the merchants and businessmen in the Western European states were demanding a greater voice in the politics of their countries.

A.E. Moodie (1957) observes: "The political history of the Modern Age is largely the study of the successful struggle to wrest...omnipotence from an individual or from a privileged few and, through the growth of parliamentary government and the extension of the franchise, to bestow self-government." Europe's revolutions in industry, commerce, and agriculture were paralleled by a socio-political revolution as well. During the second half of the eighteenth century and much of the nineteenth century. Europe witnessed the rise of nationalism as an all-pervading political force. People transferred their prime allegiance to their territory, their state—a state that they helped create through participation in a revolution that swept away the old order. The prime example of this process undoubtedly is the French Revolution, the revolution that eroded the Czarist era in Russia is also considered a case.

Idea of the state in the post-French Revolution period in the nineteenth century underwent a further change with liberty, freedom, democracy, and fraternity, having formed the basic ingredients of it. The geographical consequences of this change in the idea of the state in the post-Revolution period, and particularly in the post-Napoleonic period, were the realignment and redrawing of territories, based on ethnic criteria followed by the emergence of some more states in Central Europe.

However, the Russian Revolution in the present century added equality and fraternity to the idea of the state, while the technological developments have made the idea of the territorial state obsolete, and a large number of states with ethnic-cultural distinctiveness came into being. If we attempt to trace out the root of the idea of the change in the concept of the state, then we have to look back to the Protestant Reformation Movement which destroyed the Church-State relationship and redefined sovereignty in its spatial context.

Protestant Reformation : The Protestant Reformation introduced a new idea of individuality and individual autonomy into European thinking. Martin Luther denied the church's position as mediator between God and man; he preached individual responsibility for one's soul. If each man is responsible for his own soul, why not for his own politics? The doctrine of individual responsibility for the after-life bears the seed of the doctrine of individual responsibility in this life. How then could the church any longer sanction king's divine right to rule? Political philosophers struggled to develop a new theory of the nation and the state, and in the eighteenth century, the Reformation and the ideas of the Enlightenment finally combined to break up the church-state nexus reached in 800. The Swiss philosopher Jean Jacques Rousseau replaced the notion that sovereignty resides in the king with the idea that sovereignty resides in the people themselves, and he laid the foundation for allegiance to the state as the people. Man was thought to be capable of perfectibility, however, through social action. Politics was the instrument not only of physical protection, but of moral redemption. Perfectibility and virtue became attainable only through absolute identification with a majority will expressed in the government. The theory demanded a new level of individual dedication to the state which became the most implicative social institution. "To be a citizen was the greatest pride...".

Bergman (1975) observes: "The French Revolution sought to introduce the reign of national liberty, and it gave birth to the French nation. The Declaration of the Rights of Man stated that 'the principle of all sovereignty resides essentially in the nation; no body nor individual may exercise any authority which does not proceed directly from the nation'. The nation is the political community; it feels that it belongs together and that it ought to enjoy self-government. A state is a political authority, and ideally, it is representative of a nation, hence a nation-state. As the means of achieving community and virtue, the nation-state usurped the role of the Church, and as the sole repository of sovereignty it usurped the role of the monarch. The revolutionary slogan of liberty, equality and fraternity inverted the older religious tradition, conceiving fraternity as the goal of political action, rather than the starting point. While pressing for immediate liberty and equality, however, the revolutionaries scarified many imperfect fraternities while awaiting the establishment of a political Utopia."

Origin of the Nation State

The evolution of the nation-state may be traced through four broad phases: pre-agrarian, agrarian, industrial, and post-industrial. In pre-agrarian societies, tribal loyalties and patriotism predominated. Hunting and gathering bands were typically too small and isolated to allow for, or require, the existence of an independent political institution. Agrarian societies, in contrast, were mostly state endowed. The emergence of literacy and a specialized clerical class made possible the centralized organization and storage of records, rules and culture. However, communities remained isolated, and the clerisy could not dominate beyond localized territories.

Industrial society, however, permitted a specialized division of labour and the emergence of a high culture. In such a complex society, a centralized state agency takes over the role of socialization, education and authority. In the post-industrial society, the state has grown to play a dominant role in social relations. "A new world organization is evidenced in the development of supranation-states, based on such things as trade and defense agreements."

Concept of Nation State

The modern idea of the state, particularly that of the nation-state, was the major innovation of the Revolutionary Europe in the nineteenth century that the people with the cultural distinctiveness based on political *raison d'etre* and iconography must have the freedom to decide their destiny through the political organization of their territory. This idea first spread across Europe and gradually over different parts of the world. Therefore, the idea of the modern state, particularly that of the nation-state, has spatial-temporal dimension and must be studied in this perspective.

During the nineteenth century nationalistic ideas matured in Europe, most often based on cultural-linguistic distinctiveness, but maturation brought a change through the century. The struggle for new national political systems and states to emerge from old empires and feudal states produced a new competitive nationalism. The concept's original liberal humanitarianism became aggressive exclusivism. Emphasis on the dignity of the individual yielded to emphasis on the power of the nation, and national politics, born in efforts to reduce the absolutism of the sovereign, were transformed into exaltation of the government. The seeds of these developments can be seen in Rousseau's original ideas, and their fruits has seen many a nineteenth and twentieth century wars.

The nation-state concept emerged triumphant in Europe after World War I when the European map was redrawn to achieve self-determination for nations in nation-states. Nationalistic ideas spread throughout European colonies during the twentieth century and today the concept of the independent nation-state covers the entire globe. The power of the church in human affairs is considerably declined, and most surviving monarchies are not sources of power, but only icons of the national unity.

Thus, while the modern nation-state is theoretically the political expression of a nation, state and nation can be differentiated. In most European cases nations antedated and demanded political expression in states. Throughout most of the rest of the world, however, the territorial pattern of states is largely the remanent of patterns of colonial administration. As these areas have gained independence, state structures have struggled to evolve political values and institutions commanding the loyalty of the state populations. As the people in a state mature politically, it is hoped that the feeling of nationality, of belonging together in a political community comes to be based less in obvious cultural indices such as language/religion and more in common adherence to certain political concepts and ideas associated with the state.

Each state must win the allegiance of its population. Most of the African states are artificial units, geographical expressions carved on the map by European imperialists. These are the units which have to be tried to turn into nations. Many Asian states force the same difficulty and even many Latin American states, which had been independent for over one hundred years, still have not welded the state populations into nations.

Modern Concept of State

It is the innovation diffusion of the modern idea of the state, and particularly of the idea of the nation-state, that the question of the internal functions of the state arises and the state is created to develop the state-idea and to defend it. "The fundamental internal function of the state-area", writes Hartshorne (1950), "is to establish itself as an effective unit in fact, rather than merely in international law. This requires the conception and establishment of an idea of the state, a purpose or set of purposes, sufficiently strong to overcome the centrifugal tendencies resulting inevitably from the separate and divergent interests of the diverse regions that are included, in a particular pattern, in the structure of the state-area."

"The basic centripetal force must be some concept or idea justifying the existence of this particular state incorporating these particular regions, the state must have a *raison d'etre*— reason for existing."

What really constitutes the state-idea? Preston E. James (1968) answers it: " The state-idea is a complex of traditions, experiences and objectives. It is made up of written history, folklore, stories of national heroes, religious beliefs, and the language and art forms in which these things are communicated. It is the body of literature, the painting, the architecture, the music which are distinctively national. And it is the characteristic economic, social and political institutions. The state is created to defend and develop the state-idea...".

However, "the state-idea is not always easy to identify.... Although the identification of the state-idea requires direct contacts and close observation within the state itself. It is not easily quantified; yet these attitudes and objectives can be measured, and certainly they can be mapped...Of course, a state with a positive state-idea to which the great majority of the citizens adhere with enthusiasm is a relatively viable state... and viability is a measure of the effectiveness with which a state can be administered to fulfil the purposes (state-ideas) for which it was created."

Some geographers claim that the state-idea and *raison d'etre* are not necessarily the same; that a state may have a *raison d'etre* without a developed state-idea (which generally comes later) and that conversely the state-idea may develop in a state without a strong *raison d'etre.*

With regard to the *raison d'etre* of the state, Hartshorne

(1940) observes: "Any state, to become well established, must present to the population of its areal parts a distinct *raison d'etre,* its justification for existence as an areal unit separate from the neighbouring state-area. This *raison d'etre* must be based upon desires or values of first importance to the population of the regions included in the state...These include, notably, religion, language, and literature, historic memories and the form of government...Since few states are homogeneous in all these respects, the problem is to construct a *raison d'etre* that will enlist the loyalty of the regional groups having different associations and ideals."

The concept of the modern state is necessarily linked up with the concept of the state-idea and *raison d'etre* and the relevance of the concept is readily manifested in the world economy itself, where each state with a distinct state-idea-*raison d'etre* is intensely involved/engaged in commercial competition and mercantilism, for its development and benefits and with a view to fulfilling the purposes or a set of purposes it has presented to its citizens.

The following discussion concentrates on the theories of the state. However, some political geographers have criticized traditional political geography for its dearth of theory and in particular its failure to consider the issue of how to theorize the state. Taylor (1985) observes that "the problem is not that political geography has had no theory of the state—it is impossible to study any phenomena without an implicit theory of its nature—but rather that the theory being used has not been adequately presented so that the full implications are not expressed." Here we shall discuss the Marxist theories of the state, and the state in the world economy.

Marxist Approach

"It is well-known that Marx himself never developed a theory of the state. It was a project that he set himself but never completed. Hence, Marxist theories of the state are products of his many followers and this has inevitably led to alternative interpretation of what such a theory should say: there is not a Marxist theory of the state but many Marxist theories of the state."

Two ideas have dominated Marxist political thinking. The first, from the Communist Manifesto of 1848, dismissed the state as nothing more than, "a committee for organizing the affairs of the bourgeoise", and the second, manifesting the state as consisting of a 'base-super-structure model' of society where this engineering analogy is used to depict a foundation of economic relations upon which the ideological and political superstructure is constructed. These two simple ideas are difficult to accommodate to the complexities of the modern state. If they are taken into consideration they will lead to reduction of all politics and the state to a mere reflection of economic forces. Such crude reductionism is called 'economism'. The theory of the state which Lenin proposed reflected economism. He found a deep relationship between stages of economic development and types of state. "Hence parliamentary democracy gives rise to the form of state of competitive capitalism, the bureaucratic-military state comes up with monopoly capitalism, and socialism replaces these with the dictatorship of the proletariat." In modern orthodox Marxist theory, economics and politics are fused in another stage known as state monopoly capitalism. However, Lenin provided the model of economism which was every much as developmental as the cycle theory of states or even Rostow's stages of economic growth. However, the modern Marxist theorists have sought to avoid the model of economism in their theories of the state.

State Pluralist Theory

The pluralist theory conceptualized the state as a set of institutions which manages the public needs of society. These institutions are neutral bodies to which different groups in society can appeal and so formulate policies that favour their members. The state is in effect an umpire adjudicating between competing interests. Since modern society consists of very many overlapping interests—labour, farmers, business, home owners, consumers and so on—no one group is ever able to dominate the state. The balance of interests served will vary as governments change but the state will remain pluralist in nature and able to respond to a wide range of interests. "This is quite obviously the opposite of the Marxist class theory which in these terms is strictly a non-pluralist account of the state."

There are two fundamental properties of pluralist and related non-Marxist theories of the state. The first is that the state is treated as neutral, it is a body above the day-to-day politics of its constituent institutions. The second property of such theories is that they treat the political sphere as separate from the economic sphere. This is the basis of the whole notion of a 'political science', of course, so that no problem is envisaged in the relations of politics and economics. They are separate, though as autonomous systems. However, the pluralist theories of the state represent an important example of the poverty of disciplines.

Economism and pluralist theory can be seen as opposite ends of a scale measuring the autonomy of the political from the economic. At the economism end there is no autonomy. At the political science end there is absolute autonomy. In between them there are different degrees of 'relative autonomy', where politics is not determined by economic processes but is not independent of them either. However, most modern Marxist analysis have located themselves in the relative autonomy sector of this scale and it is from such a position that Ralph Miliband launched his attack on the pluralist theory in his book, *State in Capitalist Society*, published in 1969.

The bulwark of the pluralist theory is the existence of elections. "In 1848 the state may have looked very much like a one-class institution but with franchise reforms the modern liberal-democratic state looks very much like the pluralist model." However, Miliband sought to uncover the class nature of the apparently pluralist state. His method is to marshal data on the social, political and economic elites of the modern state and to show that they all come from the same class background. By showing the many interlinkages in terms of family, education and general economic interests, Miliband is able to paint a picture of a single dominant class in which pluralist competition is a myth. This dominant class is able to manipulate the state apparatus irrespective of which party is in government. This is known as the 'instrumentalist' theory of the state. It restates the class basis of the state and completely contradicts the neutral pluralist view.

However, N. Paulantzas, in his book, *The Problem of the Capitalist State* (1969), argued that Miliband's empirical approach, in his instrumentalist theory of the state, was seriously flawed because it involved analyzing the state on terms laid down by non-Marxist Theory. It is not that empirical analysis is wrong in itself but the way in which it is integrated with the theory is important. He goes on to say that Miliband's study reduces to a description of particular roles within the state apparatus and investigation of links between people carrying out these different roles. The inevitable result is an emphasis on interpersonal relations which is reminiscent of the original pluralist thinking. To Paulantzas, the class nature of the state is not a matter of empirical verification or falsification. A state is not capitalist in nature because a dominant class with capitalist links manipulates the state for capitalist ends. The state is capitalist because it operates within a capitalist mode of production. This puts constraints on the range of action that is possible so that the state has no option but to conform to the needs of capital. The introduction of liberal democracy does not change this fundamental characteristic. It seems to be a logical argument for which empirical proof appears to be unnecessary. Such a 'structuralist' position need not reduce to economism. However, he shares Miliband's relative autonomy assumption with the state dependent on the economic only in the last instance.

Derivative School and Relative Autonomy : M. Dear and G. Clerk, in their work, *The State and Geographic Process: a Critical Review* (1978), attempted to introduce into geography the Miliband-Paulantzas dichotomy at the same time when the works of the erstwhile West German Marxists also appeared in J. Holloway and S. Picciotto edited book *State and Capital* (1978) and this completely cuts across the arguments that sought to separate Miliband and Paulantzas.

This 'derivation' school rejected the notion of relative autonomy and so undermined the arguments of both protagonists. By assuming relative autonomy any theory implicitly accepts the separation of the economic from the political. By doing this the proponents of such theories cut politics off from the main motor of change in capitalist society—the accumulation process. For the derivationists, therefore, the key question is not about the 'degree' of separation between the political and economic, but why does it 'appear' this way in capitalist society. Both Miliband and Paulantzas cannot answer this question because they have forsaken the "holism of political economy".

"A Marxist theory of the state must be derived from the mechanisms and concepts described by Karl Marx in his basic theoretical work, *Das Capital.* To the need for competition in the economic sphere they add the need for cooperation in the political sphere. The state becomes necessary to counter the self-destructive processes of unbridled economic competition. This may even involve political processes that appear to be anti-capitalist. The evolution of the welfare state, for instance, involves ensuring the reproduction of a skilled and healthy labour force for the long term interests of capital. In this role of coordinating capital and reproducing labour the state may appear neutral and above the political conflict between capital and labour. This is why non-Marxist theories of the state appear so reasonable and are so widely and easily accepted."

Gramsci's Hegemony Concept : All Marxist theories incorporate some notion of ideology in their formulation but it is referred to in this context to theories that specifically emphasize the state as a form of mystification whereby class conflicts are hidden behind a national consensus. This is very close to the conception of the state as the scale of ideology. It is the work of Gramsci and his followers which is most closely associated with scale of ideology in the Marxist literature. Gramsci is most well-known today for his concept of hegemony. This derives from Marx's original argument that the ruling ideas in a society are the ideas of the ruling class. In Gramsci's work hegemony is the political, intellectual and moral leadership of the dominant class which results in the dominant class actively consenting to their own domination. Hence, alongside the coercive state apparatus (police, army, judiciary, and so on), there is the ideological state apparatus (education, mass media, popular entertainment and so on) through which consent is generated. Notice that these ideological functions need not be carried out by public agencies—in this theory the state is much more than just the public sector.

Historically, the vital battle for state sovereignty involved subjugation of other authority within the state's territory, both local magnates and the universal ideas of the church. In the latter case, the issue centered on education and the state's attempts to 'nationalize' its population by converting religious education into a state ideological apparatus. The successful combination of coercion and hegemony will produce an integral state. Here one can get a parallel with the Hartshorne-Gottmann tradition of the territorial integration theory and the concept of state-idea and iconography. The notion of hegemony, however, is much more pervasive and directly derives from the class-basis of the state. In this argument, Marx's original 'committee' assertion of 1848 remains broadly true: the difference between then and now merely relates to the changing relative balance between coercive and ideological means of control.

However, these Marxist theories have attempted to approach Lenin's economism in different ways but they have not tackled the problem of Lenin's developmentalism. Although we have brought the argument a long way forward from simple economism, all the analyses described above remain rooted at the state level.

Economy and State's Existence

"The political sphere that we deal with in this study is not the single state but the whole inter-state system. Hence, we need a theory of states where the multiplicity of states is a fundamental property of the theory. Clearly none of the above offer this type of theory. Nevertheless, the various themes highlighted above do provide pointers toward provision of four need and our approach does clarify some of the contentious issues"(Taylor, 1985). In the following discussion, an attempt has been made to bring together all theories of the state and the world-systems approach.

Forms of State

The basic empirical problem confronting the Marxist theories was that the same economic system—capitalism—was producing different state forms. Although the USA and Italy were both capitalist states, for instance, they showed altogether different politics. It is this variety of politics which was to be the subject matter of Marxist analysis. The break with economism was obviously necessary and relative autonomy was a very attractive concept upon which to base these new analyses. We have seen earlier that the derivationists have serious doubts on the validity of this position but they have not replaced it with another means for accounting for the variety of politics under capitalism. The world economy approach does provide a simple explanation of this variety which makes the concept of relative autonomy unnecessary.

The notion of relative autonomy is implicitly based upon the idea that both state and economy cover the same territory. The issue of the relation between economics and politics is treated on a state-by-state basis for Western Europe. When viewed in this manner it is easy to see how the problems of relating one national economy to one state polity emerges. But this whole issue disappears with the world economy perspective and its multi-state system. Instead of a one-to-one problem there is a one-to-many situation—one world market and many states. Hence, we do not have to appeal to a relative autonomy argument to explain the variety of political forms that states take under capitalism. Instead there are numerous fragments of the world economy each with their particular sovereign states. Since these 'fragments of capitalism' differ from one another, there is no reason to suppose that the forms that the states take should not differ from one another. Quite simply, different fragments of capitalism are associated with different state forms. The variety of politics remains to be understood but there is no need to resort to relative autonomy for explanation.

Position of State Derivation

Dismissal of relative autonomy brings us into line with the state derivation position. But we soon find that there are problems in applying this theory to the world-systems framework. In its initial form the state is derived to overcome the anarchic consequences of a free capitalism. If we translate this to a world economy then this theory predicts a world government to compensate for global anarchy. This is, of course, quite the opposite to the capitalist world economy as conceived by Wallerstein. Multiple states are necessary for manoeuvre by economic actors on the world stage. Production of a world government would, therefore, signal the end of capitalism as mode of production. In the world economy framework, the state does operate to maintain reproduction of labour and facilitate accumulation but not at the system level where states provide platforms for their capitals to operate in the world market.

Within the state derivation school, there have been debates that have raised the issue of the world market. Some people have insisted that state derivation must start from the existence of capital at the world level and not at the state level. As will be apparent by now the world-systems approach to the state is closest to the derivationist school due to its insistence on analyzing the economic and political as complementary aspects of one overall process. However, the inter-state system and world market as two sets of relations underlying the same process of appropriation and accumulation. We did not so much drive the inter-state system from the world economy as to define it as an integral part of the overall system—it is after all one of the three fundamental characteristics of the world economy identified by Wallerstein. But we need to go further and attempt to understand the variety of states within the inter-state system. No rigorous theory for this exists but enough material is available for us to draw the outline of such a theory.

A Space-Time Introduction : The form that states take depends upon the particular conjuncture of economic, social and political forces in its territory in the past and at the present time. Hence, strictly speaking, every state form will be unique, and can be generalized in terms of the space-time structures.

Particular conjunctures can be aggregated into a simple 3x2 matrix with time represented by A and B phases of growth and stagnation and space apportioned between core, semi-periphery and periphery. We should be able to discuss the form that states take within each of these six positions. In all cases the states will have to carry out two basic tasks:

(i) provide the conditions for accumulation of capital, and

(ii) maintain legitimation of the system. In the following discussion, we will extend the ideas of O' Connor (1973), based as they are on German derivationists, that states generally lie within the space-time categories of the world economy. In particular, we will consider the legitimation function as a varying balance between forces of coercion and consensus.

Core states are the most stable and consensus has been far more important than coercion in maintaining control. This is because the capitals of core states are strongly placed in the world market and can pass on some of their surplus to core labour. This is the process of social imperialism. It is much more than simple bribery, however, and involves the incorporation of labour into the system. These are the truly 'hegemonized' states. But the strength of this hegemony varies between A and B phases. In periods of growth, more resources are available to keep the system stable. These are the periods of building hegemony in the wake of union successes, social security and advances and finally the welfare state. With the onset of stagnation, pressures to maintain conditions for accumulation lead to cut-backs in public expenditure with resulting dangers in the loss of legitimacy. In core states, however, the hegemony has coped remarkably well with the current B phase.

The opposite situation obtains in peripheral states where instability dominates. Here there is no surplus to buy off labour which is largely left to fend for itself while being coerced into submission. The result is an 'overdeveloped structure' relative to the economic base. But this does not represent strength, it reflects the weakness of peripheral states in the world economy. As before in our arguments overtly 'strong' states deceive by their appearance. It may be argued that in post-colonial societies, a military bureaucratic group emerges to oversee the interests of three exploiting classes: (i) the metropolitan core interest, (ii) the local urban industrial interest, and (iii) the land owning interest.

These three 'capitals' have a common interest in maintaining order as the basic condition for accumulation. But they compete in terms of relation of the state to the world economy. Generally speaking, metropolitan core interests and local landowners favour an open economy whereas local industrial interests favour protection. This is the peripheral/semi-peripheral strategy dichotomy. To the extent that urban-industrial groups are able to leave their interests promoted by the military-bureaucratic regime, the state becomes more like a semi-periphery state. But such promotion can fail, of course, and the state will sink even lower into the periphery. The case of Ghana and the failure of Nksumah's 'African Socialism' is an example of this. It is a matter of the pattern of opportunity existing for advance in the world economy which varies with A and B phases, of course.

Lastly, we come to the most interesting examples, those of the semi-periphery state which are the most dynamic sectors of the world economy where political actions by states can affect the future structure of the system. This is where class struggle is greatest and where the balance between coercion and consensus is most critical. State governments in this zone specialize in strategies which emphasize accumulation as mentioned earlier. Semi-peripheral economic policy is all about 'catching up', it is the zone of protection in particular and mercantilism in general. This will make legitimation difficult so that much of the semi-periphery is associated with dictatorial regimes. But coercion itself is a very expensive form of control and will stretch resources to the extent of hindering the 'catching up'. Hence, the semi-periphery is also associated with powerful consensus forces, specially fascism and communism and generally nationalism. These are strategies for mobilizing the state's population behind the dominant classes without the greater material expenses of social imperialism of the core. Putting nation before the self, has become the most important form of consensus, the basis of state hegemony, and the major centripetal force in the twentieth century.

Finally, we come to the point that the analysts have examined the theory of the state, through consideration of its functions. These include the view of the state on:

(a) supplier of public goods and services;

(b) regulator and facilitator of the economy;

(c) social engineer with an agenda of its own; and

(d) arbiter between the many groups which compose the society. A more complex debate has been initiated in the neo-Marxist literature which begin with the question: why is it necessary to constitute an agency called the state in the society? The search for an answer to the question has prompted a very wide debate. The two most common answers have focused on the instrumentalist and the structuralist viewpoints. The former seeks to link the state elite and the ruling classes. The latter examines how and why the state operates with respect to class conflict and contradictions inherent in the social system.

Later debates have examined the state as an input-output mechanism. Its outputs consists of administrative decision taken in the interests of diverse social groups; its inputs are constituent demands and mass loyalty. If the outputs do not satisfy the various constituencies a 'nationality crisis' results, in which the viability of the state is brought into question. This may lead to a 'legitimation crisis' if mass loyalty to the state is withdrawn.

A very common view of the state is, therefore, as a 'crisis-manager'. The state acts to contain the political repercussion of the socio-economic system. The local state is a key instrument of crisis management, as is the recent trend toward 'corporation'. Corporation refers to an institutionalized form of group or class conflict, in which formal avenues of conflict and compromise are established and maintained in order to minimize the risk of unpredictable crisis. The expansion of the state apparatus is an important manifestation of contemporary corporatist relations.

The question of the state is of vital importance in the rebirth of political geography. Some analysts question whether or not, we need a theory of the state. Others claim that a theory of the state is of fundamental, central significance to a proper theory of modern political geography.

Evolution of the Word 'Nation'

The words 'nation' and 'nationalism' come from the Latin word 'nasci' meaning 'to be born' and imply 'common ancestry' and 'place of origin'. 'Nation' is intended to describe an historic entity whereas 'nationalism' is the ideology associated with this concept. To Hartshorne (1950), a nation represents "a feeling of kinship, of belonging together, an extension of the concept of family, more properly an extension of the concept of the in-groups versus outsiders. While usually expressed in terms derived from the language of the family—terms like 'blood, breed, race, etc.—it is in reality less of kin and more of kind—similarity of cultural rather than of biological characteristics."

However, John Stuart Mill, writing as early as in 1861, defined a nation as "a portion of mankind united among themselves by common sympathies which do not exist between them and any others—which make them cooperate with each other more willingly than with other people, desire under the same government and desire that it should be government by themselves exclusively." As Bertrand Russell (1938) put it: "A creed or sentiment of some kind is essential to social cohesion, but if it is to be a source of strength it must be genuinely and deeply felt by the great majority of populations."

A nation is, therefore, " a group of people, occupying a particular area, who feel themselves held together in terms of common acceptance of particular values that are of such prime importance to them that they demand that their areas and people should be organized in a distinct state, as the political agency by which those values may be preserved and furthered'" (Hartshorne, 1950). However, Hartshorne's definition is in a sense more confined to the nation-state. The definition of Graham Smith (1986) is more expressive when he defines the nation as " a community of people whose members are bound together by a sense of solidarity rooted in a historic attachment to territory and a common culture and by a consciousness of being different from other nations". It is this definition which makes the concept of nation as necessarily spatial or geographically the most expressive.

However, if a nation is defined to be a historic community sharing a common culture then such entities (communities) can be identified throughout history. The people of ancient Egypt, or the people the Indus Valley would constitute a nation on this criterion. Amin, however, in 1980, attempted to propose just such an approach to the concept of nation as part of his wider attempt to rid the theories of their Euro-centric bias. P.J. Taylor (1985), in his analysis, observes that "however much we might sympathize with Amin's motives, most studies now agree that the concept is much more useful if its use is restricted to the modern world economy. The best way of satisfying these differences is to adopt Smith's (1982) approach where the nation is interpreted as the modern version of the older category 'ethnic community'. Hence world empires of the past may have incorporated ethnic communities but only in the modern world-system have such communities driven for recognition as nations."

Anderson (1983) considers the nation to be above all else an 'imagined community' for four reasons:

(a) despite the limited bounds of an individual's activities, the nation is associated with a larger sense of communion to that of his or her local environment;

(b) it is imagined as limited in geographic reach by finite, if elastic, boundaries beyond which lie other nations;

(c) it is imagined as sovereign and thus the ideal is freedom in a sovereign state; and

(d) it is imagined as community based on a territorial relationship which subsumes other community cleavages.

Karl W. Deutsch (1953) attempts to make some distinctions between some terms which, though, appear common, but, are essentially different. He makes a distinction between a 'society' which is defined as a group of persons who have learned to work together, and a 'community' which is defined as a group of persons who are able to communicate information to each other effectively over a wide range of topics. Similarly, a 'country' can be distinguished, which is a geographic area of greater economic interdependence and thus a multiple market for goods and services, from a 'people', which is a group of persons with complementary communications habits. A 'nation' is then a people which has gained control over sortie institutions of social coercion leading eventually to a full-fledged 'nation-state' and 'nationalism' is the preference for the competitive interest of this nation and its members over those of all outsiders in a world of social mobility and economic competition, dominated by the values of wealth, power and prestige, so that the goals of personal security and group identification appear bound up with the group's attainment of these values.

"While peoples are found at almost any period in history, nationalism and nation have occurred during only a few periods. A nation is the result of the transformation of a people, or of several ethnic elements, in the process of social mobilization."

Conceptual Growth

"The processes of partial social mobilization and of nation-building", says Deutsch (1953), "have been recurrent phenomena in history, at least, in certain general characteristics. What uniformities can we find in this growth of nations in the past? And in what ways is our own age different in respect to the growth of nations from any age that has gone before?"

Uniformities which have been found in the growth of nations include the following:

a. "The shift from subsistence agriculture to exchange economies" seems to have characterized all classes of wider national integration. Where the exchange economy came to embrace the bulk of the population and to bring many of them into direct contact with each other in the interchange of a wider variety of goods and services, there we find a tendency to national character, or least, regional, linguistic and cultural awakening...where these shifts take place, the ethnic and in part the linguistic situation becomes, as it were, loosened or softened and capable of setting again into new and different molds.

b. "The social mobilization of rural populations in core areas of denser settlement and more intensive exchange": The shift to an economy and culture based on wider interchange takes place at different times and differentiates of speed in different regions. The result is often the existence of more 'advanced' regions side by side with more 'undeveloped' ones. The former are then often in a position to function as centres of cultural and economic at traction for some of the population of the latter and thus to become nuclei of further integration...Political geographers have sought to identify core areas around which larger states were organized successfully in the course of history.

c. "The growth of towns, and the growth of social mobility within them, and between town and country": There is no developed nation, it appears, without towns which have or have had a period of considerable growth, of mobility within the towns, and of increasing ties of social mobility, communication, and multiple economic exchange between town and country.

There have been towns, of course, where one or more of these conditions did not exist, and to that extent national development has been incomplete, absent, halted or retarded. On the other hand, to the extent that there was such growing mobility and communication within towns and between town and country, national development was accelerated.

d. "The growth of basic communication grids, linking important rivers, towns and trade routes in a flow of transport, travel and migration": Most nations do not seem to have grown from single centres. Many nations have had several capitals and have shifted their central regions several times in the course of their history. Even the classical example of growth around one centre, France, for long had two capital cities—Paris and Orleans; and some significant phases of the unification of the French language took place at the Champagne fairs and along the trade routes leading through that region—not to mention the role of the North-South routes and connections in helping the North to consolidate its victory over separatist and Albigensian elements in the Midi during the religious wars of the thirteenth century. A more extreme case, Germany, has no single core that could easily be identified and it seems more helpful to think of Germany as essentially a grid of routes of traffic, communication and migration.

The same notion of a basic grid seems to be applicable to the unification of China, Russia, Switzerland, Canada and United States. It would be interesting to investigate the relationship of such a grid to the incomplete unification and more recent separation of the areas that now comprise India and Pakistan.

e. "The differential accumulation and concentration of capital and skills, and sometimes of social institutions, and their 'lift-pump' effect on other areas and populations, with the successive entry of different social strata into nationalistic phase". A major factor in national differences and national pride today are the differences in the general standards of living. To some extent such differences tend to cut across the differences between social classes; there is a social, moral or traditional component in what is considered 'bare subsistence' in a given community, or in what counts as 'luxury' in another, and significant of what is considered the poor population in a relatively wealthy community may be appreciably better off in terms of physical goods and services than even many of the relatively well-off members of a poor or economically backward people. This difference between the generally prevailing standards of wealth, comfort and opportunity among different regions or peoples has sometimes been called the 'Kulturegefalle' by German writers who have employed this concept to bolster claims to German supremacy or exclusiveness vis-a-vis the populations of Eastern Europe and the Balkans.

It should be clear that, as technology progresses, the relative importance of the man-made factors of production, such as capital and skills, has tended to increase relative to the importance of the few natural facilities which were the only ones that more primitive technologies could exploit. There is a reason to believe that present-day differences in living standards are due far less to differences in natural factors of production and far more to differences in the supply of skilled labour, schools, housing and machinery.

Particular peoples and nations may then tend to crystallize, as it were, around particular concentrations of capital and technology, or of particular social institutions which offer individuals greater opportunities for the pursuit of goods or factors which they have learned to desire. Thus, in different parts of the world, we find growth of peoples around specific social institutions or specific concentrations of economic opportunity.

Where large economic or industrial developments have taken place, they have had a 'lift-pump' effect on the underlying populations. They have induced migration of populations to the regions of settlement, employment and opportunity, and put these newcomers into intensive economic and political contact with the locally predominant peoples, and with each other. The physical, political and economic contact had one of the two-cultural and linguistic -consequences: either it led to national assimilation, or, if national assimilation to the dominant group could not keep pace with the growing need for some wider group membership for the newcomer, then the 'lift-pump' effect would tend to lead eventually to a new growth of nationalism among the newly mobilized populations. Eventually, it might result in the assimilation of some previously separate groups, not to the still-dominant minority, but to the 'awakening' bulk of the population.

The intensity and appeal of nationalism in a world of sharply differentiated income and living standards perhaps may tend to be inversely proportional to the barriers to mobility between regions and classes, and directly proportional to the barriers against cultural assimilation, and to the extent of economic and prestige differences between classes, cultures and regions.

f. "The rise of the concept of 'interest' for both individuals and groups in unequal but fluid situations, and the growth of individual self-awareness and awareness of one's predispositions to join a particular group united by language and communication habits": The concept of a nation is bound up with that of a national interest. Already the non-national or proto-national institutions of the city state and the princely state imply the notion of group interests and interest of state, and all these notions of national, state, or city interests imply in turn the interests of individuals. But this concept of individuals with interests has itself gained its present importance only gradually in the course of certain developments of history. Even today different regions and civilization ascribe to it different degrees of significance, and it may loose again in the future much of its present importance.

At the bottom the notion of interest perhaps implies a situation in which men are pitted against each other in a competitive situation in which some of them can improve or even maintain their positions only at the expense of others.

Nationalism is one peculiar response to this double challenge of opportunity and insecurity, of loneliness and power. Men discover sooner or later that they can advance their interests in the competitive game of politics and economics by forging coalitions, and that they stand to gain, the firmer these coalitions can be made, provided only that they have been made with individuals and groups who have to offer in this game the largest amount of assets and least amount of liabilities. To form the firmest possible connections with the most promising group of competition would seem to be sound long-run strategy. With which group such firm connections can be formed is by no means arbitrary; in politics and economics such coalitions will depend on the cultural patterns, personality structures and communication habits of the participants. Their chances of success will thus depend to some degree on the links that make a people, the ties of nationality.

Organization along ethnic or national lines is by no means the only type of alignment which may be tried in the competitive game. Yet, of all these problems, patterns of organization, ethnic or national alignments often combine with the greatest adaptability to a competitive world. So long as competitive institutions continue to prevail, nationalism can mobilize more people and organize them more firmly than can many competing types of organizations. The potential rewards of nationalism then grow in proportion to the potential resources of wealth and power to which members of a particular people have, or can gain, access on preferred terms.

When men seek for themselves, they thus may come to find their nationality; and when they seek the community of their fellows, they may discover once again the connection between ethnic nationality and the capacity for fellowship. In any case, the phase of self-doubt and self-appraisal tends to be followed by a phase of decision and of conscious or even deliberate identification with a group; and with the loosening of the ties of religion or status that group is likely to be a group delimited at least in part along with national lines, in terms of habits of language and communication.

Many emotionally, culturally and politically sensitive individuals react to a sojourn abroad, i.e., away from their native region or culture, with a far stronger assertion of nationalism and of allegiance to their own language, culture and people.

g. "The awakening of ethnic awareness and the acceptance of national symbols, intentional or unintentional": Group awareness seems clearly a matter of social institutions. Some secondary symbols are attached to some aspects of group life and are repeated and disseminated over and over again by an organization or institution, often for a purpose that has nothing to do with nationality, or which might even be opposed to it. After a time, the institution may change or disappear, the organized repetition of the symbols may cease— but if there were enough of a primary reality capable of being symbolized, and if there had been going on that basic process of social mobilization then the results of the dissemination of those symbols may well prove irreversible; that is partly self-regenerating, and so long as the foundations for ethnic group exist and social mobilisation and communication continue to weld its members together, national group awareness may be there to stay.

A process of social mobilization may even transform the function of existing symbols or institutions so as to turn them into agencies of group awareness, regardless of their original purposes. Thus, nationalism was promoted sometimes by a supra-national church.

Once the process of group consciousness has started, there appear also the deliberate pioneers and leaders of national awakening side by side with the awakeners of national pride and fashioners of symbols as the first organizers. Together with all this activity, we find the gradual acceptance of national symbols of national colours, flags, animals, and flowers, of anthems, marches and patriotic songs.

h. "The merging of ethnic awareness with attempts at political compulsion, and in some cases the attempt to transform one's own people into a privileged class to which members of other peoples are subordinated": What does this process accomplish and what does it aim at? When a nation has been built up and when it has been reinforced finally by the full compulsive power of the state, then four things have been accomplished:

(1) A relatively large community of human beings has been brought into existence who can communicate effectively with each other, and who have command over sufficient economic resources to maintain themselves and to transmit this ability for mutual communication to their children as well. In other words, there has been brought into being a large, comprehensive and very stable, human network of communication, capable of maintaining, reproducing and further developing its channels.

(2) There has been both an effective accumulation of economic resources and a sufficient social

mobilization of manpower to permit the social division of labour necessary for this process and to permit its continuation.

(3) There has been a social accumulation and integration of memories and symbols and of individuals and social facilities for their preservation, transmission and recombination, corresponding to the level of mobilization and integration of material and human resources, or even pointing beyond it.

(4) There has been at least some development of the capacity to redirect or reallocate, or form a new combination of economic, social and human resources as well as of symbols and items of knowledge, habit or thought—that is to say, of the capacity to learn. Some of the social learning capacity is developed invisibly in the minds of individuals; some of it can be observed in the habits and patterns of culture prevailing among them; some of it finally is embodied in tangible facilities and specific institutions. Together, all these constitute the community's capacity to produce and accept the new knowledge or new goals, and to take the corresponding action.

"On all four counts, it should be evident, the nation represents a more effective organization than supra-national but largely passive layer-cake society or the feudal or tribal localism that preceded it. On all these counts, there may be considerable contrasts between different nations. The social models accepted for imitation, the established institutions, the economic practices, and the methods of compulsion within each nation are all intimately connected with the cultural traditions and leading social classes prevailing there...yet...the worst-led nation represents, relative to its numbers of population, a greater amount of social communication facilities, of economic resources, and of social learning capacity than any pattern of ethnic or social organization preceding it."

Thus, Deutsch develops his model, illustrating eight stages of development from initial economic exchange processes to the final national stage, but his model provides an example of the error of developmentalism because nations do not simply evolve in a linear sequence. They are made and in their making they encompass contradictory expressions. The rationalism of modernity is combined with irrationality of ethnic traditionalism. The following discussion, therefore, concentrates on the elements and characteristics of the nation.

Important Elements

The analysis of a nation always reveals it to be composed of a territorial and a human element, and to be moved in its evolution by an historical/political force, a dynamism which manifests itself in voluntary and collective action, i.e., the state. The foregoing analyses have disclosed historical territories fairly well-defined (but not politically stable): Ireland, which is an island, as well as Bohemia, a plateau, rimmed by mountains which separate it from the Germanic world, and link to the rest of the Slav world by the Moravian isthmus. Poland, on the contrary, has been built in the eastern part of the European plain around a river basin lacking natural frontiers.

France has grown up in a region of passage from the Rhine to the Mediterranean, and in the main, its best lands are composed of a series of river basins, between which there are no natural obstacles to intercommunication. In France, as in Ireland, the process of unification of the heterogeneous elements has been continuous right up to the present day, but in Bohemia, the unification of the groups of Slav invaders was followed, from the Middle Ages onwards, by the establishment of inassimilable foreign groups both in the valuable peripheral regions and in the towns throughout the lands.

Nations with the greatest degree of unification, and with the most distinctive personalities, are those having no 'natural frontiers' and whose territories are in no way sketched out by nature; they have developed in regions of intense life and traffic where contact with their neighbours has often been characterized by severe friction. The flexibility of geographical framework and environment, and a position which demands the energetic undertaking of relations with the external world, together with heterogeneity of the human elements, provide peculiarly suitable conditions for the formation and development of a national spirit within the state.

The Common Pursuance : The common pursuance of a political/social and economic life, moulded by the relationships between the people and the territory, exerts a unifying influence upon the heterogeneous elements of the state, and stresses certain of their psychological and physiological traits at the expense of others.

These modifications are mirrored in each individual, and so spread throughout the whole group; becoming firmly established therein, they endow it with a distinctive personality, and the people are held together from within by the communicative efficiency, the complementarity of the communicative facilities/habits, and slowly make them a nation. The community which permits a common history to be experienced as common, is a community of complementarity habits and facilities of communication in which the territoriality is deeply rooted.

The Communicative Facilities : The communicative facilities of a society necessarily include a socially standardized system of symbols which is a language and which acts as a binding/ cementing force in the making of a nation. Complementarity is greater if it permits individuals to communicate efficiently no matter how often the people of the society change their residence or occupation.

However, “it is difficult to enumerate and impossible to measure the intangible that make a nation. Nationalities come into being only when certain objective bonds delimit a social group. A nationality generally has several of these attributes; very few have all of them. The most usual of them are common descent, language, territory, political entity, customs and traditions and religion”, says H. Kohn (1945). Identifying the basic elements and characteristics of a nation, particularly those of the forces of cohesion for the integral community, Reinhold Niebuhr (1959) observes:

> “...common language and a sense of ethnic kinship, geographic unity and continuity, a common historical experience and frame of political thought, a common area of economic mutuality, and sometimes, the fear of a common foe. Any of these forces may be defective, but they cannot all be defective if the unity of the nation is to be preserved. A common religion was usually regarded as an equally prerequisite until modern religiously pluralistic nations...refuted the theory. It is worth noting, however, that only solid communities bound by other ties of mutuality can afford the luxury of religious pluralism.”

Common Language : A common language is the most frequent and obvious sign of social cohesion. Customs, traditions, folkways, feasts and festivals, costumes and decorations can all be evidence of national cohesion. “We think of the people of France as being French. Their Frenchness is demonstrated primarily by their common use of the French language, though this is spoken also by a significant part of the population of both Belgium and Switzerland. But within the whole body of French speakers, the French themselves are distinguished by a complex social ideas and attitudes. These have, in turn, been shaped through centuries and are known to us 'French tradition' or 'French culture'. This is the cement which binds the people together and make them cohere into a nation." However, customs, traditions, folkways and festivals etc. can also be evidence of regionalism powerful enough to threaten the integrity of the state.

Some of the national movements in the nineteenth century Europe began with the assiduous cultivation of everything pertaining to customs and folklore of the national groups of which it was comprised of. The language, culture, custom, tradition, political, social and economic influences—as well as working and struggling for a common ideal—all these go to form psychological character of the unified nation. To this unity the nation owes that vitality which is expressed in the dynamism needed to combat in the external field, the dangers which beset the state, to preserve in internal affairs, its national cohesion, and to facilitate the assimilation of alien elements.

Action in the external field occurs in periods of over-stimulation, under the spur of recurrent crises from which even weak organisms derive sufficient energy for violent reaction. On the contrary, the will to common action, and the ability to absorb alien elements are manifested quietly, peacefully and uninterruptedly in the day-to-day business of normal life. The power of assimilation might almost be taken as a measure of the vitality of a nation, but this power is quite different from the coercive measures which are enforced by some governments to assimilate their allogeneous subjects.

Religion : Religion has ceased to be an important force or factor in national cohesion over much of the world. The more developed states have neither a state church nor a state religion. But in some states, observes Pounds (1972) that, "religion still provides either a cohesive or a dividing force. In (former) Yugoslavia the division between Orthodox and Catholics is, in effect a national division. The former British India split along religious lines into Hindu India and Muslim Pakistan when British rule was withdrawn. Despite the assertion in the Indian Constitution that the state has no official religion, it is difficult to deny that in fact, it has been established around the Hindu faith.

It cannot be doubted that religion is a powerful political force in the Arab world nor that the Catholic Church constitutes a significant part of the cement of the Polish and Irish nations...Indeed, the identity of a religion with an ethnic group can have very significant political consequences. The fact that Catholic Ireland was ruled by Protestant England, that Catholic Poland was partitioned between Lutheran Prussia and Orthodox Russia—in addition, of course, to Catholic Austria—gave the priesthood in both instances a unique role, both political and religious. In Poland, during the years of partition, it was the priesthood which played a dominant role in preserving a national identity."

Pounds (1972) further observes that "there is a presumption that those peoples who, through the accident of birth, inhabit a single state area will acquire the marks of the corresponding nation." "Political frontiers", says Kohn (1945), "tend to establish nationalities." The pressures brought to bear on such peoples by the society amid which they find themselves are so strong that it requires a conscious and purposeful effort to resist them. Minority and dissident groups perhaps tend, more often than not, to be absorbed or assimilated ultimately by their enveloping societies.

Thus, the Bretons have, on the whole, been absorbed by the French nation, the Welsh by the British, the Slavic Lusatians by the Germans. This process of absorption or assimilation of minority groups or national minorities by the dominant society amid which they live may be either hastened or resisted. The Prussian campaign against the Poles in the nineteenth century;

the Polish campaign against the Ukrarians after 1919; the Hungarian against the Slovak, Romanian and other minorities before 1914; the Spanish against the Catalans; and the Russian against the Baltic peoples, and numerous other groups. Such efforts may occasionally be successful; usually they leave a legacy of lasting hate. But such groups may resist the slow, quiet assertion of its superiority by the dominant group. Such resistance is rarely violent and rarely successful.

"On the other hand", Pounds (1972) rates, "if a dominant group is active in forcing its culture upon a reluctant subnation and the later is vigorous in resisting such pressure, the scene is set for a struggle for national preservation and independence. Such struggles acquire heroic proportions; they are the raw material of legend and a source of inspiration to later generations. They may provide the cement which welds a nation together, and if successful, they may create a state to match the nation. The Polish struggle against the Russian in the nineteenth century, that of the Czechs against the Austrians...of the Serbs, Bulgars and Greeks against the Turks...these are examples of the strivings of national groups to resist absorption into a larger and more powerful groups... Such experiences normally intensify the feeling of cohesion, of belonging to the group.

The most articulate nations today have in some measure been molded by pressures. The pressure may not always be an attempt by an outside power to thwart or destroy the nation; it may be merely an experience through which its members have passed. For example, in the mid-sixteenth century, the territory which now forms the Netherlands was made up of several small, separate and quarrelsome states; yet the Dutch nation was born, coherent and distinct from other national units...The birth of other nations can rarely be dated with such precision, but many have passed through an intense emotional experience which have matured them quickly."

"The French nationality was born of the enthusiastic manifestation of the will in 1789, while the English nation took the shape under Queen Elizabeth I in the second half of the sixteenth century when the kingdom was threatened by the Spanish armada."

The Indian nation was to have born in 1857 when the native feudals rose against the foreign domination but it failed to come up, not because of religious cleavages, but because of sectarian interests of the native feudals. However, the Indian peoples experienced a common historical habitation, and association during the British *raj* and also acquired complementarity of habits and communicative efficiency, but nevertheless, they failed to develop into a nation. This was largely because of the fact that territorial communal cleavages, which hitherto remained dormant, gradually became expressive and active and hardened also, and stood in the way of the dynamism which sought for the social cohesion for an 'Indian nation'. Partition along the communal lines was a great blow to the process of "the making of an Indian nation".

However, "every nation has its peculiar symbols, customs and practices, and the best word for them is iconography. The feeling of being a nation is compounded of any or all of these elements, and no two nations feel the same way for the same reasons. Many of these new states of the mid-twentieth century are arbitrary creation, whose people are engaged today in this same task of establishing a sense of unity and creating a body of national legend of which they can be proud. Each nation has a view of itself, and at the same time a concept of other nation. It knows what it perceives to be its national space, and this space it is probably prepared to defend. It may, on the other hand, embrace territory to which it has little emotional attachment and which it be prepared to abandon without too much soul searching in an emergency. The nation's concept of itself, like its attributes to other peoples, is a product of its history and tradition. It is not always a rational attitude and it is rarely devoid of a kind of self-congratulatory egotism. The folklore which helps to give a nation a sense of unity also tends to represent it as more noble, more just, more democratic than others... Perhaps no nationality has a more clearly expressed self-concept than the Chinese."

Concept and Approaches of Nationalism : It is a feeling of belonging to a nation. Or it is the desire of cultural-linguistic and religious groups to achieve a political status that would give them a limited measure of self-government, sufficient at least to allow them to project and deepen their cultural individuality. It is a doctrine based on the idea that every nation should have its own state. This idea emerged in the eighteenth century, became a major force in the world politics in the nineteenth century and has come to dominate the politics of the twentieth century. It was originally associated with the rationalism of the eighteenth century, especially the rejection of the personal authority of the monarch as the source of a state's sovereignty. Instead sovereignty lay with the people.

This notion is given political expression in the famous opening sentence of the American Constitution of 1887: "We the people...". The specific idea that 'the people' constitute a 'nation' appears in the French Revolution with the setting up of a National Assembly in 1789 and the French proclaiming themselves '*le grande* nation' in 1790. By 1815, at the Congress of Vienna, the novel idea that state should coincide with 'nation' was first expressed and the Greek independence in 1821 represents the first direct result of this idea, i.e., nationalism. Revolution between 1830 and 1848 became 'national' revolution and the concept finally triumphed at the Peace Conference in Versailles in 1919 when national self-determination was recognized as the prime criterion of the new European political order. Much of the crisis in the present-day world may be attributed to the "diffusion of the idea of nationalism"—

disintegration of the Soviet Union and Yugoslavia, reunion of Germany, division of Czechoslovakia and the collapse of the socialist system in East Europe necessarily manifest the areal/spatial expression of it, i.e., nationalism.

Diverse Approaches of Nationalism

Karl Deutsch is credited with having developed the geographical theory of nationalism in 1953. His 'communication' theory of nation and nationalism builds upon Whittlesey's nuclear area and extends it to the consideration of the communication grid of a country. A community based upon a common language and/or memories is termed a people which is separated from other peoples by a communication gap. When such a people seek power to control their own destinies through the process of nationalism, a nationality comes into existence. When power is achieved, a nationality becomes a nation which on acquiring its own sovereign state becomes a nation-state.

For Deutsch this communication involves two procedures: assimilation, by which he means additions to the community, and mobilisation, by which he means the rise of a political public within the community. The later is defined by the media etc. Finally, he combines these various concepts into a model of the growth of nations (mentioned earlier) in which he sought to analyze the stages of development, this time 'national development.' However, Deutsch's model of the growth of nation suffers from the error of developmentalism.

Nationalism, according to Nairn (1977), is the result of the tidal wave of modernization that swept Europe in the nineteenth century as a result of industrialization and urbanization which brought about many economic and social changes, particularly in western Europe. It was more advanced than in the Central and Eastern Europe. Nationalism is then a compensatory reaction to this uneven development. Beginning in the area bordering the advanced zone, the new rising urban-industrial interests were unable to compete with the more efficient core producers. They have to evolve strategies to survive, to prevent peripheralization.

The only resource available to the local capitalist interests, other than the material resources, not available to the metropolitan interests, was their cultural affinity to their 'people'. By emphasizing differences between ethnic communities, local interests could form broad national alliances with which to challenge the core. Hence regions where nationalism grew up as a major new force on the European stage were Central Europe and the unification nationalisms of Germany and Italy. From this beginning nationalism spread like a wildfire, following the uneven development unleashed on the world by modernization.

Next came the separation nationalisms of Central Europe to be followed by the nationalisms outside Europe in the twentieth century. But nationalism became more than a reaction of semiperiphery and periphery. With the demise of British hegemony, the new vigorous nationalism spread to the core as a major force in the subsequent political competition resulting in the second phase of formal imperialism. By the twentieth century, it was to become the dominant ideology throughout all zones of the world economy.

Where do the two sides of nationalism fit into this theory? So far the use of 'tradition' has been made clear but of the 'progress' side of the ideology? Although the urban industrial interests of the semiperiphery and periphery used images of an idyllic past to mobilize the people, they could not be true conservatives and present progress. The whole purpose of the strategy was to close ranks with a view to catching up the core. This could only be done by borrowing the salient features of advancement and modernization against which the movement was reacting. A medieval Germany or Italy would be no match for a modern Britain or France. Hence, the rhetoric of nationalism with its glorifications of the past was ultimately only a cover for rapid modernization. The classic case is, of course, late nineteenth century Germany where massive industrial growth went hand in hand with a popular German cultural revival.

Nationalism gives the people back their tradition and provides an identity in an alien world. It is for this reason that nationalism is particularly associated with periods of radical disruption such as wars, etc., and with strong charismatic leadership, as has been the case with the Indian nationalism under the charismatic leadership of Mahatma Gandhi. Nationalism, however, acts as compensation for the alienation of mass society.

The intellectuals played a dominant role in the rise of nationalism. The new class of intellectuals of the nineteenth century Europe, often from lower-middle class backgrounds were able to provide the historical, philosophical, ethnographic and even geographical basis of the new nationalisms. The intelligentsia were the agents of refraction, the most advanced part of the new national middle class.

Nairn (1977) postulates a social diffusion process beginning with a small intelligentsia, initially reacting to the French Revolution, which he terms phase A. This is followed by phase B from 1815 to 1848 in Europe where the ideology spreads through the middle classes. But it is still a minority movement and this accounts for its ultimate failure in the 1848 revolution. Phase C occurs in the second half of the nineteenth century in Europe when it diffuses to the lower classes and modern popular nationalism is born. The intelligentsia were, therefore, the initial purveyors of ideas to be used for the general interests of their class.

Blaut (1980) takes strong exception to Nairn's 'relegation' of class struggle to below nationalism, the association of nationalism to fascism in the Janus model and more specifically to the Euro-centric 'diffusionalism' of Nairn's model which underrates the contribution of the non-European periphery to nationalism and national liberation in particular. Blaut provides an alternative space-time identification of nationalism with the source in USA (1776) and Haiti (1804). Blaut's critique raises several important questions involving definitions and whether identification of nationalism as a false consciousness relegates or enhances the fundamental importance of class struggle. Nevertheless, Nairn's model provides a major attempt at explaining nationalism that transcends the ideology itself.

Various Types of Nationalisms

Orridge (1981) presents a typology of nationalism, in which, he identifies five basic types:

State Nationalism : This is the nationalism of the core states. This nationalism is the source of much dispute over the timing of the emergence of nation and nationalism. Earlier patriotism was nothing but loyalty to monarch or state or even country but not to the collective idea of a people as a nation incorporating all sections and classes. Nevertheless, the centralizing tendencies of these states within relatively stable boundaries did lead to a degree of cultural uniformity and cohesion by 1800 which was not found in other areas of comparable size. England and France are the key examples but similar nation-states were emerging in Portugal, Sweden, the Netherlands and, to a lesser extent, Spain. In all of these cases "state preceded nation and it can be said that state produced nation". The result was proto-nation-states. The 'people' were entering politics but nationalism as an ideology was not fully developed until later in the nineteenth century. Hence, the nation preceded nationalism.

Unification Nationalism : This type of nationalism was characteristic to Central Europe where medium-sized states were prevented from evolving under the contradictory pressures of small (city-scale) states and large multi-ethnic empires. There were a mosaic of small independent states mixed with provinces of larger empires, such as Germany and Italy. This type of territorial-political pattern came into being in Central Europe largely as a result of the Treaty of Westphalia in 1649 but the French Revolution, followed by the Napoleonic wars after 1800, disrupted the pattern in Central Europe.

Although, the Congress of Vienna in 1815 attempted to reconstitute the old territorial political pattern in Central Europe, but by the time new forces had been unleashed to dominate the rest of the century. Nationalism was the justification for uniting most of the German culture area under Prussian leadership into a new German nation-state and transforming Italy from a mere geographical expression to an Italian nation-state. These are the examples of unification nationalism and in these two cases "nation preceded state". The re-union of Germany in the post-Cold War period seems to be a natural manifestation of unification nationalism.

Separation Nationalism : Most successful nationalisms have involved the disintegration of existing sovereign states. In the nineteenth and early twentieth century this nationalism lay behind the creation of a large number of new states out of the Austro-Hungarian, Ottoman and Russian empires. Beginning with Greece in 1821, a whole tier of new states was created in Eastern Europe from Bulgaria, through the Balkans to Scandinavia. Emergence of a large number of nation-states in the post-Cold War period, following the disintegration of the Soviet Union and Yugoslavia, may be attributed to separation nationalism. This type of nationalism was, until recently considered to be a phenomenon of the past at least in core countries.

'Autonomous' nationalism of this type is appearing in Punjab, Jammu & Kashmir and all north-eastern states of the

Indian Union but none of these has, at present been successful in establishing their own nation-state, but the Indian Union is contemplating to grant more political autonomy to them, even at the cost of amending the constitution. Here, in the separation nationalism, it is the nation which preceded the state, and it can even be said that nation produced the state.

Liberation Nationalism : The break-up of European overseas empires may be attributed to the national liberation movements. The earliest was the American war of independence in 1776 which finally led to the creation of USA, independent of British control.

The Latin American revolutions after the Napoleonic wars were more explicitly 'nationalist' in character. These can be considered liberal nationalist movements. In the twentieth century such movements have invariably been socialist nationalist movements varying in their socialism from India's mild version to Vietnam's revolutionary version. "Another way of dividing up liberation nationalism is between those based upon European settler groups and those based upon indigenous peoples.

In the former case, we have the USA and Latin American republics, and the original white Commonwealth states of South Africa, Canada, Australia and New Zealand who negotiated independence without liberation movement. In the latter case, most of the Afro-Asian states come which have become independent since 1945." Here in this category, the state concept preceded both nation and nationalism.

Renewal Nationalism : In some parts of the periphery 'ancient' cultures withstood European political capture for a variety of reasons and were able to emulate the state nationalism of the core, often using polities similar to unification nationalism. These states had a long history as ethnic communities upon which they could easily build their new nationalism. National renewal for former greatness became the basic cry. Hence, Iran could rediscover its Persian heritage. Turkey after losing its Ottoman empire could concentrate on its Turkish enthnicity. The classic cases of this type of nationalism are to be found in Japan and China. "This form of nationalism can also occur as part of a process of creating a new state identity which attempts to redefine the relations of the state to the world economy. As such, this renewal is associated with the modern revolutions. Stalin's socialism in one country had many of the trappings of a renewal of the Russian nation. Other renewals have occurred in Mexico, Egypt, China and most recently in Iran."

Taylor (1985) observes: "Political leaders in a wide range of contexts have been able to appeal to the nationalist doctrine to justify their actions...On the one hand, it is a good thing, a positive force in world history as when it is associated with weak states freeing themselves from foreign oppression. But it also has a dark side, the negative force associated with Nazism and Facism in Europe, and militarism, throughout the semi-periphery and periphery.

It is, as it were, both good and bad. This is most clearly seen in attitudes to nationalism after the two world wars in the twentieth century. In 1919, the First World War was blamed on the suppression of nationalism; in 1945 the Second World War was blamed on the expression of nationalism." To Nairn(1977) nationalism is like 'the modern Janus' after the famous Greek statue which looked in two directions at once, both backwards and forwards. To him, it is the essence of the ideology, a simultaneous appeal to both progress and tradition.

There is no denying that nationalism is recognized as a legitimate force in international geopolitics. The creation of the League of Nations and then of the United Nations Organization was largely based on the doctrine of nationalism that each nation-state, represented in the international organization, must have global expression of its national character. However, nationalism is easier to define as a doctrine than it is to define on the ground, and the difficulty was realized when the new nation-states had to be carved out of the territories of the defeated states of Germany and Austro-Hungary as per the guidelines of the Treaty of Versailles after the First World War.

No doubt, national self-determination provided a simple guide to this process—states should be formed around nations as determined by the people. In fact, people were allowed to decide to which nation-state they belong or should they have a separate state-area for them, or how to determine their nationality?

It is through plebiscite that the nationality of the people was determined. Plebiscite was not a new method to ascertain the territorial character of a nationality. It was used immediately after the French Revolution to legitimize the extension of the French State, and as a tool in the unification of Italy and Germany. In some of the cases, a different criterion other than the plebiscite, was followed to determine the territorial character of the nationality, and that was to follow the linguistic pattern of the people. The language criterion was accepted as a legitimate indication of national preference, but still there remained the problems of defining national languages and mapping their distribution.

Linguistic reorganization of the Indian Union in the 1950s, and the process which is still continuing, has implicitly recognized the principle of 'national self-determination' of the major linguistic groups, with a consequence of mutually exclusive sub-national movements.

Taylor (1985) observes that "Nations do not exist as neatly packaged bundles of peoples waiting for a state to be drawn around them. No less than states, nations are man-made and reflect the politics in which they are created. Any theory of nationalism cannot, therefore, be merely a theory of ethnic distribution, rather it must be a theory of political construction of nation.

Nation Building Approach

The concept of nation-building is more relevant to poly-ethnic states, particularly to the 'mutually exclusive' multinational states.

Though "nation-building may be viewed as the process and the devices through which the sentiment of loyalty for the nation-state is fostered and fissiparous and divisive tendencies are pacified and eliminated", but in reality, "it refers essentially to the process", says Dikshit (1982), "of bringing together culturally and socially discrete groups into an organic (i.e., fully functional) spatial system and the establishment of a strong national identity inseparably bound with the territory of this system.

There are four important aspects of this process: First, progressive development among the constituent political communities of a deep and unambiguous sense of identity with the state and its ideals. Secondly, the broadening and intensification of social communication among the constituent communities and regions.

Thirdly, social, economic and psychological commitments are eroded and the people become available for new patterns of socialization and behaviour. Lastly, improvement of transport facilities by minimizing physical distances and thereby facilitating a greater flow of goods and services between the different regions of the state. This and the development of mass media and growth of urban centres by bringing the different components of the state's population together, give rise to common norms of behaviour that reinforce a sense of unity and national identity."

Hartshorne's concept of state-idea is more appropriate to the nation-building process, whereby the diverse/mutually exclusive regions can be brought together under a common organization, so that the state may achieve an integrated personality. To Weiner (1965), nation building refers "specifically to the problem of creating a sense of territorial nationality which overshadows—or eliminates subordinate parochial loyalties."

The study of territoriality, state, nation, nationalism and nation-building has assumed special significance, especially in the light of the major politico-geographical changes in Eurasia in the post-Cold War period and in Africa as a result of ethnic violence, ethnic cleansing and xenophobia, etc.

10

International Borders

The Significance

Frontiers and boundaries as spatial expressions of main social and political organizations and territorial partitioning have always been recognized and identified to be of prime importance as structural elements in the political geography of the state. Both frontiers and boundaries are, by definition, the peripheral elements/features of politically organized space, and in most of the non-geographical literatures they are often used as synonym.

But in geography particularly, they are not synonymous, and have different meanings and connotations, notwithstanding, both being the peripheral elements or features of the politically organized space. There is a fundamental difference between the two. A frontier zone is an area between two social systems or entities.

It is that geographical position at which opposite forces of expansion or resistance neutralize each other and become steady. A boundary, on the other hand, is a necessary component of the sovereignty. Sovereignty must be bounded: a world of sovereign states is a world divided by boundaries. Boundaries are, therefore, an essential element of the modern world economy.

With the rapid fall of territorial states in the past, and the rise of political entities of variable size, there was a rapid disappearance of frontiers and the appearance of boundaries, which replaced them, for "without them (boundaries) the present system of states might well be reduced to a chaotic condition, since it would be impossible to know where the sovereignty of one state ended and that of another began".

Conceptional Origin

The word 'frontier' has been derived from the Latin 'frons' (and more directly from the French 'front') meaning 'forehead', which is etymologically suggestive of "that which is in front...designated an area which was part of a whole, specifically that part which was ahead of the hinterland. Hence, it is often called the foreland or borderland, or march". The Russian equivalent of the English 'march' is 'ukraina', and that of French is 'marche', and that of German is 'mark', all meaning literally 'borderland' or 'margin'. Intrinsically, the word 'frontier' is indicative of the "spearhead of civilization."

The frontier is neither a legal nor a political or intellectual concept; it is essentially a natural/social concept as it involves in it the growth of acumen or spearhead of civilization. The Russian 'ukraina' was an example of an advancing frontier, a spearhead directed against the 'dark' and unchristian Tartary, and the Cossacks were not a nation or ethnic group but a social group, pioneer settlers and conquerors of the advancing borderlands, men not unlike the American frontiersmen. Thus, in the historical origin, the frontier was rather a phenomenon of "the facts of life—a manifestation of the spontaneous tendency for growth of the acumen. In antiquity, and later too, the frontier was on the margin of the inhabited world, but each particular acumen, for instance, that of the agricultural society as opposed to the nomad society, also had a frontier. The 'limes' of the Roman Empire were those of the acumen of western civilization".

With the development of patterns of civilization above the level of mere subsistence strictly adapted to particular environmental conditions, the frontiers between ecumenes became meeting places not merely of different ways of physical survival, but also of different concepts of the good life, and hence increasingly political in character. To Kristof, "the frontier was not the end (tail) but rather the beginning (forehead) of the state; it was the spearhead of light and knowledge expanding into the realm of darkness and of the unknown."

Since there were few ecumenes in the world which were separated by wide inaccessible-intervening areas that tended to function as frontiers, as they had no relations with the ecumenes. Therefore, their orientation was independent of them (ecumenes). So was the outlook of the inhabitants of the frontiers who were very few in numbers and had different ways of life *(genres de vie)*, much inferior to that of the people of the acumen. They were always looked upon as barbarians.

However, the part played by the human element in the shaping of frontiers was revealed in the definition of their double role/function which was to mark the maximum range of a people's dynamism and to delimit the one in which two opposing dynamisms neutralize each other.

Therefore, the frontiers had always remained a region of contact between two different sets of ways of life and in some instances, intermingling had occurred. Wide expanse of marches between the European, the Chinese and the Indian ecumenes had always been zone of overlapping of cultural realms.

Geographical Origin

In their geographical evolution, the frontiers seemed to have passed through the three distinguishing periods/phases. In the earliest phase, the frontier was no more than the limit of the state, and beyond it lay the void like an unknown ocean beyond the shore—as those of the vast expanses of territories beyond the colonies in America and Asia, particularly when the European settlements were confined to the seaboards, e.g., the vast American expanse beyond the mid-Atlantic seaboard, across the Appalachian mountains, or beyond the embryonic British colony, being crystallized on the Atlantic seaboard, was a frontier whose territorial extent was still unimportant—a geographical void that required the least organization of all. If viewed from the western perception, the entire Indian subcontinent constituted a geographical void on the eve of the European arrivals.

The second phase began with the organization of frontier marches, which lay transitional between the territory of the state and the empty regions, still in existence. The extensive territory surrounding the intensive core/acumen of many modern states originated in this way. The marchlands can be deserts, forests, mountains or marshes, and are physically a region of natural obstacles, and demographically a region of very thin population than the ecumenes.

The empires of antiquity, however much they differed from each other, were all surrounded by frontier marches. The Egypt of the Pharaohs, China, India, Persia, the Roman Empire and the Arab world were all isolated by semi-desert zones crossed only by a thin stream of traders : these zones were the primeval protective void. But most states organized these zones in a rudimentary fashion by stationing troops in them, by placing them in charge of an administrator, or by making them into vassal states. For this reason frontier marches varied in their political character.

The entire north-eastern region of the Indian subcontinent was organized into a frontier marchlands after 1826 by the British colonialists, when its inhabitants who were racially and demographically inferior to the people of the acumen, were organized/annexed in such a way as to have been placed under direct colonial administration. Moreover, the British State in India was strong enough to impose its authority throughout the north-eastern marchlands. Nepal, Bhutan and Sikkim emerged as frontier dependencies of British India in the Himalayan marches, which ultimately became its vassals.

In its final phase of evolution, the frontier changed into a frontier line. This simply happened when the acumen/civilization advanced and the marchland around it receded gradually. Some observable changes took place in the marchlands, in the meantime, which included the clearing of the forest and extension of cultivation which tended to increase its economic importance. Its demographic character also underwent changes and it was no longer a no man's land. Its physical makeup was rapidly adapted to form part of a more and more organized defence; it changed into a fortified frontier, more effective than the former isolating zone. The frontier became a line.

It became necessary in the light of the hostile and aggressive attitude of the opposing state that the frontier defence was pushed closer to that state. Expansion of civilization on either side of the frontier, particularly the marchlands, brought them closer to each other, creating a potential military situation, which necessitated the alignment of a line so as to prevent open hostilities and war. The McMohan Line was a geopolitical necessity, as the Indian marchlands in the Assam-Himalayan region was necessarily threatened by recurrent Chinese hostilities in the early part of the present century. In order to prevent China's open hostilities along the frontier, the McMohan Line was aligned along the high-crest-cum-watershed of the Eastern Himalayas.

Such, in broad outline, was the demographic, economic, political and military evolution which changed the marches and frontier zones into frontier lines.

"With the rise of the world economy, a frontier emerged between the system and the systems it was supplanting. The history of imperialism was associated with pushing forward the frontiers of this new world systems. It produced classic frontier in American West, but also other similar frontiers in Australia, South Africa, North Africa, North-West India and Asiatic Russia. The frontier ended with the closing of the world system at the beginning of this century...there are no longer any frontiers—they are now phenomena of history."

Origin of North-West Frontier : The western frontier of British India provided a glaring example of how the frontier could come up, end the phases through which it passed in course of its evolution. "The political frontier of British India lay far to the west of those hot and humid regions which, to the western perception, constituted the real India. The heights of Kashmir in the north, with an almost temperate climate, are succeeded on the south by the Punjab (the land of the five rivers), and the valley of the Indus with its gentle slope to the sea between the sand dunes of Rajputana and the Thar desert on the east, and the mountainous border of Iran on the west.

The Hindukush and the Sulaiman and Brahuis mountains form a good protective system where it was only necessary to organize the control of the passes between the mountains. But it took many years to reach this mountainous region. In the first part of the nineteenth century, the western frontier zone of British India consisted of the mountains of Kashmir in the north, the open valley of the Punjab in the centre, and the Thar desert in the south. Later, when the theory of river frontiers prevailed, the possession of Sind was desired at all cost...The mountain barrier of the north-west was reached when Dalhousie annexed the Punjab. In 1876, Baluchistan became a British frontier dependency. Afghanistan remained neutral as the buffer-state between India and Russia. The defence of the mountain passes was organized. Finally, in 1901, the North-West Frontier Province was founded—a veritable frontier march, the guardian of the most dangerous passes of the northwest, and in 1937 this province became autonomous."

Thus, the north-west frontier region was gradually built up. Firstly, it included a mountain state in the north, a river basin in the centre, and a desert region in the south. It then became necessary to extend it to the mountains bordering the opposite plateau, to complete the occupation of the mountain and the desert region to the south, and to organize the supervision of the passes and the cols. All the possibilities offered by the terrain have been recognized, tried and made use of to develop a thorough-going technical, military and administrative organization. From the plateau of Iran to India, the frontier march extends over an area equal to that of a large European state.

However, with the spread of the Anglo-Indian acumen across the western marchland, much of its function receded in the late nineteenth century which necessitated the frontier defence being pushed closer to the incoming Czarist sphere of influence towards the Hindukush, and the Durand Line was laid across it in 1895 as a part of the Anglo-Russian convention. Thus, the wide mountainous-riverine-desert frontier tract, lying west to the acumen, was rapidly developed into marchland whose limit was geographically aligned along the Durand Line. The State of Pakistan was created across this frontier marchland after it was fully integrated with the territorial-administrative system of the British raj.

Types of Frontiers

In the past, there were four distinguishable types of frontiers, viz., natural or physical frontier, ethnic or anthropogeographical frontier, geometrical or astronomical frontier, and political frontier.

Large and wide, inaccessible/inhospitable regions with absolutely no human concentrations, lying between the ecumenes, tended to constitute 'natural frontiers'. Even wide expanse of deserts/mountainous regions/river basins with inextricate features/marshes and forests within the limit of the territorial states, which were not geographically integrated with the political ecumenes but were no-man's territories, and the states had simple de facto control over them, such regions or areas were intrinsically classified as 'natural or physical frontiers' in the past.

All frontiers in the past had emerged as natural frontiers. There existed a vast natural or physical frontier in Central Asia, between the advancing Russia and the Great Chinese Wall in the antiquity. The vast stretch of the Eurasian steppe also functioned as a physical frontier between the Asiatic people and the Germanic people for several centuries. Before the advent of the Europeans, the vast Sahara was essentially a physical frontier between the Semitic and the Negroid people in Africa, as their authority or sphere of influence did not coincide with each other, but simply passed across the wide expanse of the no-man's land.

The Himalayan and the trans-Himalayan regions together constituted a broad physical frontier between China and the British *raj* as their authoritative limits were not known to each other. The great but inaccessible Amazon basin is still a wide physical frontier in Latin America. In the nineteenth century, the Congo basin also acted as a physical frontier between the black African people and the white European settlers. Natural frontiers had always remained in 'a state of flux'. This type of frontier had come into being mostly through the force of the geographical determinism. However, most of the buffer zones/ states, during the period of colonial competitions in the nineteenth century, were created across the physical frontier zones.

Ethnic or anthropogeographical frontiers were those which lay between the two or more political ecumenes, and were thinly or sparsely inhabited by the people of different racial stocks who might be culturally backward and inferior to those of the inhabitants of the ecumenes. The vast Balkan region with its Slav population in South-East Europe, was an excellent example of an ethnic frontier in the contemporary world that lay between the Turkish acumen and the Germanic acumen.

The large tract of South-East Asia emerged as an ethnic or anthropogeographical frontier in the nineteenth century, particularly during the period of colonial rivalry between the British Empire in South Asia and the French realm in Indo-China. West Asia was another such frontier in the contemporary world. The ethnic or the anthropogeographic frontier was indicative of the fact that in "the making of the frontier, human elements also played operative roles in its organization regardless of it being the gift of nature. Large number of nation-states have come up in these erstwhile/ traditional anthropogeographic frontier regions of the Balkan peninsula, South-East Asia, and West Asia in the early part of the present century. These frontiers had always remained zones of contact between differing, and often opposed human elements.

The period of colonial expansion in the nineteenth century saw the rise of a large number of 'geometrical or astronomical frontiers' drawn on almost empty areas of partly unexplored continents; the frontiers consisted of straightlines and were drawn across the unknown interior territories, regardless of the territorial features or ignoring all geographical reality. These frontiers were the result of colonial rivalries between European powers over extending their spheres of influence across the unknown/unexplored interior territories of Africa. They began from a point on the African coast where they first settled, and from there they decided among themselves, on the empty map of Africa, the political realms of their colonial control, with the help of meridians and parallels, ignoring the geographical reality of the partly explored continent. The limit of their sphere of influence landward, passed through unknown territories which were intrinsically discernible zones with varied spatial characteristics. The westward expansion of the American State from the Atlantic coast against the retreating Indians, and the invasion of the British descendants who pushed the Australian aborigines into obscurity and the frontier expanded regardless of the territorial features, because the interior was still unexplored.

Be it the American west or the Australian interior, or European territories in Africa, they were all under the 'de facto' control of their territorial masters. The development of the marches was confined to the coastal ecumenes and landward; they were either ephemeral or intermittent in nature.

There was a vast 'political frontier' from the mountainous border of Iran in the west to the Hindukush mountains in the east, between the British empire in South Asia, the Turkish empire across South-East Europe and West Asia, and the Russian empire on the northern periphery of the frontier. This vast mountainous-cum-desert frontier was the result of a spontaneous tendency of growth of the British State in South Asia, Turkish State and the Russian State on the Eurasian periphery. It was more a part of the British frontier philosophy to keep this frontier alive with a view to perpetuating its political authority in South Asia, in response to expanding the Russian frontier into the Slav-held territory of the Turkish empire. The Assam and trans-Himalayan Tibetan frontier was a political frontier which sought to distinguish between two different political systems—the British and the Chinese. Political frontiers were more rapidly organized into marchlands because of their 'fluid' political character.

Apart from the above types of frontiers (which are now the phenomena of the past) there are two more types of frontiers, viz., 'ideological' and 'settlement'. Ideological frontier existed till recently over a wide area in Central Europe between the Soviet realm in East Europe and the Atlantic-Mediterranean Europe. This ideological frontier was the genuine manifestation of the cold war between the two power axes—Washington and Moscow—which soon began after the Second World War. This frontier was a zone that sought to distinguish between the two different economic systems, or it attempted to distinguish between the Atlantic core and the Eurasian semi-periphery system. However, with the fall of socialism in East Europe, reunification of Germany, collapse of the Soviet system, followed by its territorial disintegration, and the disunion of Czechoslovakia and Yugoslavia, the ideological frontier has disappeared. 'Settlement' frontier tends to manifest the expansion of acumen into the empty lands within the territorial jurisdiction of the state, or, in other words, it is indicative of the extension of the national territory into the area, which hitherto, remained not occupied owing to its inhospitable character. Settlement frontier is a dynamic phenomenon, indicative of the social mobility within the territorial limit of the state.

"Though frontier conditions may sometimes be deliberately created by governments, the state tends to view frontiers and frontiersmen as a temporary expedient, as appropriate to a period of transition. The ultimate goal is a boundary, not a frontier. This is what the Chinese frontier policy of keeping the Chinese in and barbarians out aimed at. Since frontier conditions affect and unsettle, the internal order and quiet, the state must, ultimately, either make an effort to integrate the frontier lands within its socio-economic-political system—to enclose them within the state boundary—or, if it cannot be done economically or at all, to exclude them from its realm: put them beyond the pale of its community."

Frontier, therefore, was an area at the margins of the integrated territory of the state, or any political unit, into which expansion might take place. The concept was essentially outward-looking and implied the existence of an unknown that was yet to be conquered, understood and assimilated. It was that zone in which at a given moment the forces of expansion of two neighbouring states tended to mutually neutralize each other.

On the contemporary world, map boundaries are the norms. The earth has been more or less accurately surveyed and precise lines delimit the territories of states. This is a recent development; prior to the twentieth century maps of the most parts of the world showed huge tracts of unclaimed land. Indeed such land on the frontier was generally regarded as a necessary 'safety valve' for accommodating the populations of fast growing states.

These 'safety valves' were mostly represented by marchlands, neutral territories, and buffer states. However, the very necessity for a boundary automatically implied that the safety valve or for that matter the frontier was under pressure from both sides and might not, therefore, be claimed as the legitimate future territory of either one or the other of the states in contact with the boundary line.

Significance of Boundaries

In terms of national politics, boundaries are important because they mark the limits of a states' sovereignty. They are drawn either where the territory of a sovereign state abuts that of another or at the farthest extent of its territorial seas. In a few cases they extend even further when jurisdiction is extended over the surface of a continental shelf but not over its overlying waters. Boundaries also extend down to the centre of the earth, according to international agreement, thus allocating rights to subterranean resources. Similar agreement has not been reached over the upward extension of sovereignty into the air space, however, because of the difficulty of agreeing on an upper limit.

The nature of boundaries has changed through historical time because their function—the separation of sovereignties—has also changed. As population became more and more dense and human settlements more numerous, and as the rights and obligations of government increased, so it became necessary to draw boundaries with ever greater precision. The modern boundary is, in most cases, a finite line along which two sovereignties meet. To Stephen B. Jones, "ideas about boundaries are related to their geographical and historical milieu". In fact, the boundary concept in antiquity was centered round "a no-man's land" which frequently separated the territory which was inhabited and used by one tribe to that of the other.

In fact, the primitive tribe had a frontier perception of the boundary, which, in the true sense of the term, reflected unclaimed, unsettled and unused territory into which peoples from each side might at times intrude but over which neither side claimed or exercised an exclusive control. Even today, some of the African primitive people still hold the view of an unclaimed territory, defining the zone of an 'authority'. The Chinese and the Roman boundary concepts of antiquity also manifested an idea of a stable and exact frontier which ought to be secured through the erection of frontier wall. It was intrinsically sought to perpetuate a clear-cut limit between themselves (Chinese or Roman) and the barbarians. The Chinese and Romans were not the only wall builders. The early Anglo-Saxons built walls to defend their authority over the land they ruled.

The ruler of the medieval or feudal state did not know precisely how his state was made up, its boundaries were closely defined only here and there, where for some reason or the other, there had arisen a need for precision. It is a strange reversal of our present state of affairs to find that medieval rulers did not know the extent of the lands they ruled and, when they were in doubt, consulted the local people.

A well-known feature of feudalism was that it produced a patchwork political map. Discontinuous holdings were common and were tolerable because of the decentralized nature of feudal rule and warfare. Some of this discontinuity persisted into the period of monarchies but with increasing dissatisfaction. The discontinuous nature of Brandessburg-Prussia was a well-known case. The two principal parts of this domain were separated by a band of Polish territory for a century and half. This was slowly whittled away. One of the tasks of subsequent centuries has been to smoothen and strengthen boundaries and to clear up the confused pattern of sovereignty in Europe. However, the process of boundary making is very different in the various sections of the world economy. Stephen B. Jones (1959) had identified six distinguishable types of boundary concepts, viz., 'natural', 'national', 'imperialism', 'contractual', 'geometrical' and 'power political'. These categories are not exclusive to one another from one perspective, for instance, we would identify all boundaries as reflecting the power politics of their respective producers. Nevertheless these are useful concepts that tend to reflect the different ideas of the state in the evolving world economy.

The concept of natural boundaries was a product of the Age of Reason and of nationalism chafing at old restraints. Its origin was largely the product of the French Revolution of the late eighteenth century. When the revolution swept away the remnants of French feudalism, the concept of natural boundaries took predominance over historical claims.

In contrast to the French expansionist idea, implicit in their doctrine of natural boundaries, the German developed the concept of boundaries based on folk or nationality. "It was understandable that the Germans of the early nineteenth century, not having attained a national state, should idealise it and needing a criterion for German nationality..." Although nationality is basically a 'we-feeling' in a group of people, it embodies a strong territorial bond. The desire for territorial contiguity seems to be intensified by nationalism.

The French doctrine of natural boundary, and to that of the German concept of national boundary, were the realizations of particular power-political positions in the core and semi-periphery of the contemporary world economy which gave birth to the boundary doctrine of 'imperialism' in the nineteenth century itself. European imperialism provided a worldwide sense of space and opened up an immense exploitable world. Friedrich Ratzel is credited with having laid the foundation of the tradition of the boundary doctrine of imperialism. In one of his seven laws of state expansion, he observed: "The frontier is, as a peripheric organ of the state, the bearer of its growth and its security, conforming to all changes of the state organism." It was the character of the state as an organism which appeared to be the very basis of the doctrine. The organismic concept came out with an analogy between such biological frontiers as timber-line and the frontiers between human groups. The German geopoliticians later made use of the concept. Ratzel's tradition was carried forward by Lord Curzon who later developed the concept of scientific frontier, i.e., a frontier that sought to unite natural and strategical strength, "by placing both the entrance and the exist of the passes in the hands of the defending power". It is only in the periphery that the European imperial powers made use of this doctrine of boundary when they moved into it.

In fact, in the periphery itself that these types of boundaries emerged. In the non-competitive arenas in the nineteenth century, such as India and Indo-China, the boundaries reflect the one core state at the expense of weak pre-capitalist social formation. This is where frontiers were extended and then converted to boundaries. The limits were finally achieved when two powers began to approach one another's peripheral territory. The process led to the formation of a buffer state in the periphery as in the cases of Afghanistan between Imperial Russia and British India, and Thailand between French Indo-China and British India.

The contractual concept of boundary and the concept of geometrical boundaries appeared to have developed simultaneously. The contractual concept of boundary was largely a product of the American State, the essence of which was that "two states should agree on a line and stick to it, as individuals agrees on property lines". Whereas the doctrine of geometrical boundaries had European origin which envisaged the use of long geometrical lines as boundaries with some geodetic sophistication.

In competitive arenas, the boundaries are usually far more arbitrary since they reflect 'contractual' and 'geometrical' arrangements between the competitors. These were done to prevent disputes between them. Boundaries in such competitive areas either follow physical features or simply geometrical lines of longitude or latitudes. Examples of contractual-geometrical boundaries are, of course, the USA's western boundaries to north and south along the 49th Parallel and the Rio-Grande, respectively. Contractual-geometrical boundaries largely occur in Africa which had been the most competitive peripheral arena in the nineteenth century. Here, the concepts of 'natural' or 'national' boundaries had no relevance as ethnic groups and river basins were divided up in complete contrast to the boundary then evolving in the core.

The power-political boundary concept had its origin both in America and in Germany also, but in a different perspective and situation. The westward expansion of the American State, at the expense of the weak natives, was basically power-political, as it reflected one of advances of the strong and retreats of the weak. The German perspective on power-political boundary was the product of inter-war geopolitics, which looked upon boundaries "as the biological battlefields in the life of people".

The essence of this concept was that boundary was not only a line demarcating legal systems but also a line of contact of territorial power structures. Specific boundaries at any given historical period become then merely the politico-geographic expression of the existing balances offerees at that period. Power-political boundaries not only emerged in the periphery only but also in the continent where the Franco-German boundary and the German-Austro-Hungarian boundary in the late nineteenth century reflected the contemporary territorial contact of power structure. Similarly, the pre-war German boundaries in the twentieth century also reflected its power-political expression, thrust upon its neighbours. The McMohan Line also manifested balance offerees between British India and China.

Boundaries in the post-war scenario have tended to coincide more with the features of nationalities. Boundaries in East Europe, in particular, reflected the territorial contact of the various nationalities. The post-Cold War scenario in Europe also reflect the same tendency that states are breaking up on nationality lines and their boundaries expressively coincide with the patterns of nationalities. In Asia-Pacific regions, the international boundaries reflect the same old tradition as one that thrust upon them by the core states during the period of the colonial competition, though China and others have expressed displeasure over such alignments. In Africa, the nineteenth century 'contractual-geometrical paradigm' still prevails, though independent African states are now opposing such territorial alignments imposed on them by the core states. Thus, modern international boundaries reflect contrasting processes in the core and periphery which are the hallmarks of the world-systems approach.

Step-by-Step Development

Boundaries are one of the spatial expressions of the given legal order as they are supported by 'jural laws'. They are man-made politico-geographical occurrences. A boundary does not exist in nature or by itself. It always owes its existence to man. A survey of the global patterns of boundaries will reveal that they have evolved through (i) 'arbitrary process', (ii) 'evolutionary process', and (iii) 'arbitration process.'

Boundaries in the peripheral competitive and non-competitive arenas seemed to have evolved through the arbitrary actions of the core states, regardless of the local territorial and human elements. They were more of administrative convenience rather than of compromise, and expressive of 'colonial expediency'. The British Indian boundary along the Himalayas was expressive of what may be called a 'unilateral' action of arbitrariness, without taking into confidence the opposite party. Great majority of boundaries in the periphery had been arbitrarily aligned by the imperialist core states to their satisfaction and political sustenance. Imperialist boundaries and power-political boundaries, imposed on the peripheral territories also reflect arbitrariness. Even in Europe, boundaries in the past had evolved in an arbitrary manner. The post-feudal period in Europe had witnessed arbitrary alignment of territories and the boundaries evolved accordingly.

The American State and the Australian State, both have acquired their present territorial size through arbitrary process of territorial aggrandizement at the cost of the weak social formation of the original inhabitants/natives. Internal federal boundaries have been drawn up unilaterally, regardless of the territorial human elements. Geometrical boundaries in Africa had long been drawn up in an arbitrary manner, in a sense, that they did not conform to the geographical reality of the continent. Boundaries, drawn up arbitrarily without reference to the territories and peoples, are usually *de facto* in nature. Boundaries, which are the product of contract between the concerned territories and peoples, have developed/grown up through the evolutionary processes involving certain phases. The ideal sequence of events in the establishment of a boundary is as follows: The first stage involves 'negotiation' between the concerned states which leads to the 'description' of the boundary which involves the identification of location of the boundary and the terrain through which it has to be aligned. Reference may be made to conspicuous physical features, such as crestlines, watersheds, hilltops, passes/saddles, coastlines, rivers, and even to cultural features, such as buildings, farm fences, and roads. The more detailed the description, the less likely is there to be subsequent friction. This first stage, represented by the language found in many treaties, is referred to as the 'definition' of the boundary, which indicates that the involved states have agreed upon the geographical coordinates and features.

When the involved states have completed the formalities of the description and definition of geographical coordinates or features of the boundary in question, then the real job of the cartographers begins who, then, locate the coordinates and 'delimit' them on large scale maps by joining them through a line. This is the second stage of the boundary evolution. Delimitation is done with extra care and utmost caution, and cartographers of the concerned states, who delimit the boundary in the presence of their respective officials, are required to have detailed geographical knowledge of the area and the art of delimitation. Any deviation during the process of delimitation may give rise to serious disputes in the future.

The third and the final stage of the boundary making is that of the 'demarcation', i.e., the task of marking the boundary on the ground which is the job of the surveyors. Demarcation is done by various methods such as fences, pillars, stones, wires, and by mere lines of poles. Utmost caution is again maintained in the process of demarcation, so that in no way it should deviate from the 'delimited line'. Very few world boundaries are actually marked on the surface. It is an expensive process and when states do not face such problems along their boundaries as to absolutely require demarcation, they often delay this stage permanently. However, fences have been built in certain delicate areas where exact demarcation was required. Demarcation on the high crest-cum-watershed areas is extremely difficult because of inaccessibility, permanent snowfields and lack of suitable methods. Most of the mountain boundaries which pass along permanent snowfields have yet to be demarcated.

Most of the contractual boundaries appear to have evolved in this way. In the periphery itself, some boundaries have developed through the evolutionary processes, involving description, delimitation and demarcation. The Anglo-Russian convention of the nineteenth century sought to perpetuate the boundaries of Afghanistan. Boundaries which have come up this way may be grouped as *de jure* boundaries, because their alignment reflects bilateral or in some cases, multilateral agreements.

Some boundaries have come up neither through the arbitrary process nor through the evolutionary process, rather through 'arbitration', acceptable to the parties concerned. This was particularly true in the periphery. For example, the mountainous boundary across the Andes between Chile and Argentina in Latin America was the result of the arbitration of King Edward II. The award which he made in 1902 was binding on the concerned parties. When the concerned states failed to agree on the location of the boundary, they sought for arbitration. The arbitrator employs experts, cartographers and other officials so as to study the problems, to describe and delimit the boundary, and finally make the award. The demarcation of it is left with the concerned parties. The award is not always impartial. Indo-Pakistan boundary across the Rann of Kutch results from the arbitration and to Pakistan, the arbitrator has not been fair to it. The boundary has given additional strategic advantage, to India as it is alleged by Pakistan.

The evolution of Indo-Pakistan boundary, other than that which runs across the Rann of Kutch, is somewhere between the arbitrary process, evolutionary process and arbitration. The arbitrator, Sir Cyril Radcliffe was appointed by the colonial master, not by the involved dominions, and the boundary award was thrust upon them in an arbitrary manner. In the majority of the former colonial areas, boundaries had been created in such a way. Particularly, in the non-competitive peripheral areas, international boundaries have come up this way, reflecting a core-periphery relation. Evolution of boundaries in the former Soviet realm in Eurasia simply reflected the semi-periphery processes of power politics.

Important Functions of Boundaries

One of the foremost functions of a modern boundary is to generate loyalties, and to impose duties over the people, and to constraint for the sake of internal harmony and compactness and of external separateness and individuality. It tends to serve as a dominant focus of political identification for the territory it binds, defines, and at the same time, persuades the people to shift their loyalties, expectations and political activities toward a new centre. Since it is a political creation, it must function as a centripetal force, reflecting the state idea vis-a-vis the *raison d'etre* of the state which it defines.

Boundaries function as separators of territorial sovereignty (regional limits). In this role, they can function in a limited sense, as 'attractors'. Crossing points become location factors on either side for border towns whose support comes directly and indirectly from administering and servicing the movement across the boundary. In this perspective, the concept of a border landscape or border land can be elaborated into a notion of a limited mirror image effect, i.e., a great similarity between the opposite border lands in the spatial arrangement and function of certain phenomena, reflecting the impact of the same regional focus, the boundary. Furthermore, the conscious creation of official border zones by a state on the one side or by agreement or coincidence of adjoining states on either side, will tend to emphasize this marked effect on the landscape.

National Boundary : National boundaries also function as filters or screens; they are seldom completely impenetrable barriers, nor are they normally passed with so much ease as to be no barrier at all, but rather have a filtering (quality) or screening (quantity) effect on movement. Problems arise in the measurement of this impact. One can equate the barrier function for any given movement to the friction of distance in terms of time, cost or some other index. The measuring in this manner of any two movements across the same boundary will serve to indicate the individuality in the boundary's function according to the particular movement measured. It might for instance, seem to be a very minor filter for a certain commodity while at the same time it could act as a major barrier to permanent immigration. Some kinds of movements such as air waves carrying television signals can in no way be effectively controlled at the boundary in respect to this flow (aside from the location and size of the transmitter) must be made at the points of reception of the information.

Since the boundary is the meeting place of two or more different economic entities, each having different economic structure and economies, it must have intrinsic commercial function. It acts as a tariff barrier/wall, providing protection to internal industries to prosper within. In fact, it provides tariff protection to internal commodities from outside competition. The price differential on either side of the boundary usually affects the location of outlets for the products of the various industries affected by tariff provisions while the industry may prosper, the area under the shadow of the boundary may not. In the most competitive but emerging arenas of the periphery, the states have erected strong tariff wall against the core states. The European states have together formed a greater tariff wall, providing protection to their industries against the inroads of the American and the Japanese goods. The tariff-wall functions of boundaries of the European states have much declined as they are drawn more and more closer to one another. However, the tariff-wall commercial function of the boundary in the coming century will gradually diminish because of the greater flexibility in the liberalization of the global trade.

To check smuggling is another commercial function of a political boundary of the present-day state system. If smuggling from across the national boundary continues unabated, it ruins completely the national economy, making the boundary itself meaningless and ineffective. Strict vigil is, therefore, maintained all along the boundary. Check points at regular intervals are erected, and custom officials are posted there.

Political Boundary : The political boundary also performs legal functions. The state laws prevail at this line. Taxes must be paid to the government by anyone legally subject to taxation whether he resides one or one hundred kilometres from the boundary. Even though a resident living within sight of the border may have closer linguistic, historical and religious ties with the people on the other side, he is subject to regulation prevailing on his side of the boundary, including compulsory education to a certain age, selective service enlistment, and so forth. Furthermore, the national government is capable of controlling emigration and immigration at points along the border.

However, with the increasing satellite geopolitics vis-a-vis the political importance of the space, the traditional function of boundary as a line of defence has declined considerably. No doubt, political boundaries had long functioned as lines of defence. The ancient, medieval and even the modern boundary concepts, till recently rallied round its defensive character. To the major powers of the world possessing modern military equipments, however, the artificially or naturally fortified boundary is no longer an asset.

But this is not to suggest that the defensive function of the boundary has completely been lost. India is erecting barbed wire all along its tension-ridden boundary with Pakistan and also with Bangladesh which is indicative of the defensive character of it. Political boundaries of the Muslim states in West Asia do perform defensive function intrinsically while those of West European states, have ceased to be defensive.

Political boundaries in the periphery are more defensive in character while in the core, they are more economic in nature, and in the semi-periphery they are somewhere between defensive and economic in character. Hence, the boundary functions require to be viewed more from the changing core-periphery relations rather than any other. There cannot be any universal generalization of the boundary function.

Even in the periphery states with different 'core identification', notwithstanding being neighbours, have different perceptions of boundary functions. Boundary functions also tend to change between states with the same 'core identification' in the periphery, since they gained independence at substantially difficult times.

Variable character of the boundary functions is a mere politico-geographical expression of varied types of states, variable character of their genesis/growth, outlook and perception, and place in the world economy.

Kinds of Boundaries

The classification of boundaries can be carried out on the basis of two different types of criteria. They can be grouped or categorized from the point of view of their static characteristics; for example, their correspondence to physiographic or morphological features, their separation of ethnic regions, their straightness, and so forth. This is basically a descriptive classification. It tends to utilize the morphological approach in political geography. Boundaries have also been drawn to follow straightlines of latitude and longitude or arcs, and in some cases, they have been aligned in such a way as to separate ethnic communities of various backgrounds and identities. This classification is often known as the 'morphological' classification of boundaries.

Boundaries can also be classified according to their relationship with the cultural landscape. In fact, Richard Hartshorne in 1936, suggested a fundamental two-fold division, arising from the relationship between the boundary and the surrounding cultural landscape. Some boundaries were established prior to the permanent occupation of areas by the present inhabitants. In some cases patterns of settlement were already developing so that the boundary ultimately established has a different relationship to the cultural realities of the area involved. This classification is known as the 'functional' or 'genetic' classification of boundaries.

Recently, John Nystuen has suggested a new classification of boundaries in terms of their impact on activities. While not specifically formulated for political boundaries, nevertheless, this classification adds to our understanding of these phenomena.

Morphological Boundaries : It has been the tendency since long to make boundaries conform with some conspicuous natural features. Kautilya's *Arthashastra* makes an in-depth reference to physical boundaries, and if chronology is to be believed, then it can be said that the political boundaries of Chandragupta Maurya's great empire in the fourth century BC passed along the Himalayas and the Hindukush mountains. Ancient Indian kings used to prefer river boundaries where mountains were absent. Even the boundaries of Mughal India conformed with natural features. British India carried forward the same heritage of natural boundaries. Although natural features were used for boundaries for millenia before but it was not until the French Revolution in the late eighteenth century that such boundaries emerged as a major boundary doctrine. Expressively, the French doctrine of natural boundaries reflected expansionist philosophy.

Natural features have certain basic characteristics: (i) they are the most conspicuous features on the earth's surface; (ii) hence, they are easily identifiable, recognizable, and measurable not only on the surface but also on the map; (iii) natural features are intrinsically stable features and no other observable phenomena on the surface can match them in this way; and (iv) they have immense strategic values than those of others. Because of these spatial characters they have often been preferred to others, particularly when the question of politico-territorial limit of the sovereignty has arisen between states.

"Naturally marked boundaries have been subject to almost endless classification. The relative merits of different natural features for the purpose have often been examined and one kind of boundary has been preferred to another kind. Such questions, however, have little point because when such boundaries were adopted, their advantage lay chiefly in the fact that they were obvious and unambiguous. In the first instance they are not chosen because they were difficult to cross or because they presented a military barrier to invasion. It is only in the modern times that actual course of a particular boundary has come to be a matter of military significance to the state that is enclosed by it."

Morphological boundaries have been grouped into those (i) which follow the course of a mountain or hill range; (ii) which follow the line of rivers, canals, and lakes; (iii) which run through a desert, a forest or a swamp; and (iv) which conform with some other physical feature that may once have been conspicuous in the landscape.

Mountain Boundaries : Mountains have always been preferred to other natural features for boundary making, for "a definite line of watershed carried by a conspicuous mountain crest, ridge or range, is undoubtedly the most lasting, the most reliable, identifiable, the most unmistakable and the most efficient as a barrier". Boundaries drawn along mountains and hills are found to be unambiguous and obvious. Most of the traditional boundaries which emerged along the mountains and hills in the historical past, have still retained their function—both as a line of defence and a line of defining the territorial sovereignty.

Mountains and hills are unmistakably identified on the maps and hence, delimited accurately, making the demarcation on the ground much easier. However, in case of an inaccessible and very high altitude area, it is extremely difficult to carry on demarcation. Most of the high altitude mountain boundaries have been left over undemarcated. Notwithstanding their finest spatial characteristics, as the most stable, efficient, unambiguous and so forth, mountain barriers have quite often presented problems. Only in the rarest instances, there exists a clearly defined crest line, and the crest line rarely does continue far without being interrupted by a transverse valley. Normally mountains are made up of number of sub-parallel ranges separated by interconnected valleys.

Rarely does the crest coincide with the water divide. "Both sides of the highest and most continuous mountain range in the world, the Himalayas, are drained ultimately to the same river system, the Ganga-Brahmaputra delta."

A conspicuous mountain range usually has breadth and length and in its valleys may occur human societies which have adapted themselves to the mountain environment, and developed their economies accordingly. Transhumance is the most expressive human activity across the mountain ranges for the simple reason that good pastures occur on the mountain slopes, and some pastures do occur on the crest sides. There are examples that with the alignment of inter-state boundaries in such areas, the mountain dwellers have to abandon their permanent transhumance activities, as it happened in case of the Polish-Czech boundary along the Tatra, and the Slovenia-Austria boundary along Karawanke.

Most of the more formidable mountain ranges constitute minor cultural regions rather than cultural divide. Any boundary chosen to follow a chain of mountains must, unless the area is totally devoid of human clusters, break up human societies to some degree.

Most of the boundaries drawn along the mountain ridges and ranges are based on earlier maps with varying degree of errors. Seldom, features such as the crest and watershed etc. on the maps coincide with the realities on the surface/ground, causing serious disputes over the alignment. A serious dispute arose between Chile and Argentina over the alignment of boundary along the Patagonian Andes because the map which was used for the delimitation for the 1881 treaty was not truly expressive of the region.

As a result both states had different interpretation. There was no crest line in the Andes, the water-divide did not conform with the higher ranges but the map showed the coincidence between the two. It was through an arbitration of Edward VII that Chile and Argentina finally agreed to comply with the Boundary Award made by His Highness in 1902. The *de facto* McMohan Line between India and China which was delimited on the maps, prepared by the British official to follow the high crest-cum-watershed of the Eastern Himalayas, may not conform with the ground realities of the region. The crest is not continuous and there are numerous interruptions by transverse valleys. Mountain boundaries which follow the crest-cum-watershed present serious problems to demarcation, nonetheless, they offer greater durability and desirability in the politico-geographical arena.

River and Lake Boundaries : Rivers and lakes have the advantage of being more clearly marked on maps and more narrowly defined on the land than mountains and hills. Rarely are there any problems with the river boundaries as with the crest line and watershed as their continuity is often interrupted by transverse valleys, making the definition almost difficult. Another problem with the definition and demarcation of the mountain boundary is that seldom does the crest line conform with the watershed when majority of maps show a clear-cut coincidence between the two. This cannot happen in case of a river. For this reason, rivers in particular have been used in boundary definition and delimitation. Rivers since long have acted as barriers to movement and performed their separating functions especially well if flood plains were wide, increasing the difficulty of crossing them. As obvious, continuous and permanent features in the landscape they were protective barriers.

Against the use of rivers as boundaries, it has often been said that they do not usually coincide with the divisions between human societies. There is a tendency for the whole valley of a river to emerge as a distinct region, and also to become a unit for purposes of water use and human settlement. The river valley possesses a regional functional unity of its own while a mountain range does not often possesses that quality. Ancient states flourished in river basins. Rivers have long functioned-as important arteries of trade and transport. Large rivers usually have major basins, economic and cultural, and even political development on both sides is often similar but the alignment of political boundaries across them has undoubtedly disrupted settled communities, creating major problem in the utilization of water, and also in the flow of traffic. The alignment of the Indo-Pakistan boundary across the Indus and the Ganga basins in 1947 has created more human problems than before.

Any definition of a river boundary will have to be more specific than merely to state that it "runs along the river". The alignment of river boundary is done either (i) along the median line; or (ii) along the centre line of the navigable channel or the principal channel (thalweg); or (iii) along one of the banks.

The median line is a line equidistant from the river banks. The problems here are obvious. If the river is navigable, the navigable channel will swing from one side of the river to the other, and if the median line is the boundary this means that the navigable channel repeatedly crosses the international boundary thus established. In order to mark the median line, the exact location of the banks must be known or agreed upon, and this, in a river of changing volume and a wide flood plain, presents difficulties.

It was decided in 1920 that in navigable rivers the boundary should follow the principal channel or the thalweg. Since then, it has been the most frequently adopted method. Navigable channels are the deepest parts of the rivers but are rarely or never exactly in the middle of the stream. They are subject to constant modification. Thus, although the buoys marking the international boundary stay fixed at the surface, the navigable channel may undergo such significant shifts that is no longer possible to use it on both sides of the line of buoys. This requires frequent adjustment and maintenance by the concerned states.

No less confusing are boundaries which have been aligned to follow one bank of a river or the other. Such boundary lines have not always been deliberately chosen; they have arisen from the clumsy and ambiguous wording of treaties and agreements that were made at a time when such matters as the precise relationship of the boundary line to the river were not considered important. If the definition of the boundary states that "it will run along the contact between land and water on the right bank", then the boundary will shift with the changing volume of water of the river. This would be intolerable. If the boundary is fixed then part of the non-riparian state is flooded and this would mean that it had right to water, which by definition, cannot share. It is, therefore, observed that this criterion of river boundary is far from satisfactory. For nearly 64 kilometres, the boundary between Iraq and Iran follows the left or the northern bank of the *Shatt-el-Arab*, and is the potential source of disputes between the two Muslim states in West Asia.

It has been found that the course of a river may gradually change through erosion of one bank and accretion on the other. It is also liable to sudden change when the river abandons its old bed and flows on a new. This change in the course of a river also brings about an equally gradual shift of boundary while the avulsion or sudden shift of the stream does not, and in such a case or situation, the boundary shall continue to follow "the centre of normal channel" which has been fixed earlier.

Even if the river abandons its channel and goes dry, no alteration of the earlier location of boundary is permissible. This principle has been followed between the USA and Mexico along the *Rio-Grande* which has been notorious for frequent changes in its course. Sometimes, the formation of outlines of a state's territory beyond the main stream of the river itself and which are not frequently accessible by a bridge poses serious politico-administrative problems for the concerned states. The common practice to deal with such problems is to eliminate the outliers of territory within purview of the negotiation, definition and delimitation, as has been done between the USA and Mexico along the *Rio-Grande*.

One of the potential problems resulting from the changes in the river courses is that of frequent occurrences of Chaurs or islands in the valley, which in most cases, gives rise to serious boundary problems between the involved states. All great river boundaries normally suffer from this problem. These islands, sometimes become productive, and the farmers of one state may raise crops there while of the other state may harvest them.

The state may collect revenue from the migrants who temporarily migrate to such islands for cultivation. If the Chaurs or islands become permanent, then problems tend to become permanent. Some such islands in the river may have strategic importance, and in that case, the concerned states may attempt to occupy them, leading to potential war-like situation. The *Amur* and the *Ussuri* rivers are littered with such islands which have long given rise to serious river boundary disputes between China and Russia (former Soviet Union). An island in the *Muhuri* river between Tripura (India) and Bangladesh has created considerable tension between the two states.

Indo-Bangladesh river boundary along one of the dead channels of the Ganga (the Matabhanga) has always remained a source of tension between the two. The river boundary does not follow any particular bank or the midstream or the principal channel nor is there any median line drawn across it, but its course has changed considerably. Both the states have failed to evolve any compromise formula. Similarly, the shifting course of the *Ganga* between Murshidabad (India) and Rajshahi (Bangladesh) has always been a source of tension between the two. Here, the shifting is due to erosion along the right bank and accretion along the left bank. Since the boundary along it has neither been aligned along any particular bank nor along the principal thalweg, the dispute is of a perennial nature.

Lake boundary usually follows the median line as in the case of the USA-Canada boundary across the Great Lakes.

Lakes do not present such problems as the rivers do, hence lake boundaries are more stable. There are some pertinent questions with regard to the median line formula in determining the boundary across the lake. Does it divide the lake into two equal parts? Is it a line (at all points) equidistant from either shore? Or is it a line drawn through the middle points of a number of lines drawn from shore to shore across the lake? These questions require to be settled bilaterally between the involved states.

However, the median-line formula has not been adopted in the division of Lake Victoria in Africa between Uganda, Kenya and Tanzania. The division is based on lines of latitude and longitude drawn from the points where international boundaries of these states reach the water. But the boundary between Zimbabwe-Rhodesia and Zambia across the man-made Kariba Lake follows the median line.

Forest, Swamps and Desert Boundaries : These features on the earth's surface had served as frontiers in the historical past because of the ambiguous extent and scanty population. In fact, they were no-man's tracts between the settled communities and functioned as cultural and defensive barriers. The forests of North-East Europe have been cultural barriers, separating Finn from Russian, Russian from Lithuanian, and Lithuanian from Pole. Some of these barriers have been changed into boundaries when they narrowed down with the gradual penetration of human communities.

Though swamps are less extensive and less effective as cultural barriers, they played decisive role in space politics. Marshes along the lower Rhine and Meuse valleys played the most significant role in the emergence of subsequent political boundary between Belgium and the Netherlands. During the inter-war period, the Pripet Marshes in White Russia were traversed by the boundary between Poland and the former Soviet Union. The boundary between the Sind province of

Pakistan and Gujarat province of India traverses across the marshy Rann of Kutch which has been settled through an arbitration.

The boundary between India and Pakistan that runs north-east-wards from the Rann of Kutch to the Sutlej passes for the most part of it, through the Rajputana and Thar deserts which are sparsely populated. Earlier, these deserts were a part of the great western frontier that lay west to the British *raj*. The Sahara, the most extensive of the deserts, has throughout most of human history, separated the distinctive cultures of tropical Africa from those of the Mediterrarean basin.

National or Anthropogeographic Boundaries : As mentioned earlier, the national boundaries are the product of the German reaction against the French doctrine of natural boundaries which sought expansion at the cost of the nationalities. National boundaries are the mere reflection of attempts which sought to perpetuate self-determination based on certain ethnic qualities. As national consciousness ripened, it demanded that boundaries should be drawn with ever increasing attention to the aspiration of people. The transition from medieval to modern concepts of boundaries was, therefore, bound up with the rise of nation-state. Unification of Germany and unification of Italy in 1871 provided the impetus to such alignment of boundaries which followed ethnic, linguistic, religious and other dividing lines in the cultural landscape. Much of the crisis in the Balkan peninsula in the first decade of the present century arose simply because the communities there demanded that the boundaries of their territories must be drawn with utmost accuracy and attention to the national aspirations of their people.

The 1919 Treaty of Versailles laid special emphasis on national boundaries, and the territorial alignment in the post-First World War in East Europe was done in the light of the spatial distribution of the communities involved. As the number of nation-states emerged they sought to perpetuate their identity based on their cultural distinctiveness. The importance of physical boundaries declined substantially and those of national boundaries increased. States which emerged during the inter-war period and after the Second World War, as a result of the nationalist movement, have their boundaries drawn along ethnic and cultural features. The Indo-Pak boundary which was thrust upon the dominions follows the religious cleavage. Most boundaries, with the exception of some of those in Latin America and new states of Africa, are national boundaries.

The alignment of national boundaries has, in most cases, led to the transfer of population and the creation of minority problem. No state can be said to be inhabited solely by the community for which it has been created; there may be people, though in small numbers, belonging to other communities also, which may have religious/cultural ties or affinity with the people of the state on the other side of the boundary. The division of British India on the religious pattern in 1947 left millions of Muslims in India and millions of Hindus in Pakistan. The division was followed by large-scale transfer of peoples but still peoples in substantial number remained in these two states as minorities, creating intense communal problems. Alignment of national boundary also leads to 'forced' influx of people who move to neighbouring states as the refugees. Post-war history is full of examples of 'forced migration' of one ethnic community by the other. Even people who have developed territoriality for generations are uprooted and driven out of their territory.

Internal federal boundaries of the Indian Union have been made to follow the regional linguistic pattern which have given rise to intense regional rivalries within the Indian State. National or anthropogeographic boundaries are not as sharply defined on those of the physical boundaries and because of their ambiguous character, they can create political disputes within and outside. National boundaries have created more problems than physical boundaries; nonetheless, they are most preferred.

Geometrical Boundaries : Boundaries which have been made to follow lines of latitude or longitude or in some cases, as drawn from fixed points, are known as geometrical or astronomical or mathematical boundaries . They are the product of the Age of Imperialism and Colonialism. The earliest example of such a boundary can be traced back to the late fifteenth century when the Pope divided the still undiscovered parts of the world between Spain and Portugal. It was in the Treaty of Tordesillas in 1495 that the earlier alignment made in 1481 was amended and the boundary was defined to have passed along the meridian running 370 leagues west of Cape Verde Islands. Several centuries after, the delineation of the northern boundary of Florida was agreed upon between the USA and Spain, using the 'straight line' method in 1795. In 1818, the 49th degree of latitude was recognized as boundary between the USA and Canada.

It was at the Berlin Conference in 1884-85, attended by the European colonial powers that geometrical boundaries were preferred to other boundaries for such areas as in Africa which were still partly undiscovered and unclaimed. Preference to these boundaries sought to establish the limits of their hitherto ill-defined sphere of influence across Africa. Geometrical boundaries reflected only the relative power of the states concerned, paying no attention to local conditions and desire of the indigenous people. These are all arbitrary boundaries, imposed from above or thrust upon the people. Geometrical boundaries are easy to define and delimit on the map and their demarcation on the ground with modern methods of survey presents no problems. There is a superficial similarity between meridians and parallels and other straight lines drawn between points, known as turning points. A number of boundaries are actually made up of a series of short, straight, oblique (i.e., neither north-south nor east-west) segments traced between turning points.

Many boundaries in Africa, West Asia, Middle East, Russia and Australia are, in fact, oblique. A geometrical boundary may come up across a truce line or along a ceasefire line and that too, depends on the nature of compromise between the states—powers involved. The 38th parallel in Korea was established in 1945 as the boundary between North Korea and South Korea by negotiation between the USA and the former USSR. The 17th parallel was the boundary between North Vietnam and South Vietnam, separating the Chinese sphere of influence and the French realm in Indo-China. However, with the unification of Vietnam in the early 1970s, this boundary disappeared. If Korea becomes one, the 38th Parallel will automatically disappear.

A final category of geometrical boundary consists of an arc of a circle drawn with a prescribed centre and radius. The boundary of Gambia in Africa belongs to this category. It has been drawn with a series of arcs of circles with their centres and radii on the *Gambia* river itself as the boundary runs parallel to it. Examples of this category of geometrical boundaries are rare and unimportant also. The geometrical boundary is being used today as a possible solution to the division of the Antarctica continent where spheres of influence between the major powers have begun to develop recently.

Geometrical boundaries are politically successful only when they are defined/delimited/demarcated before the development of settlements. Regardless of errors in demarcation they pose no problems but if they are defined and demarcated after the development of settlements, problems and disputes are bound to occur because in that case, the alignment is done ignoring the ground realities and desire of the communities. A great majority of African native communities are now demanding reorganization of the territories which must conform with the national aspirations of the people if they lie across the boundaries.

Sometimes the form of any one boundary can be classified equally well under two or more of the above types (i.e., a river can be a cultural divide or a geometrical divide), it is, therefore, necessary to have an open-ended type, known as 'complex'. Furthermore, any given boundary between two states, especially if it be a long one, will usually vary in its form from place to place, and hence becomes a mix of several of the above forms. This is known as a 'compound' boundary. Finally, if the boundary neither follows the physiographic feature nor any cultural features, and which is not a geometric one, it is then called as 'indeterminate' boundary.

Functional or Genetic Classification of Boundaries : Functional or genetic classification of boundaries is based on the relationship between the boundary and the cultural landscape at "the time the boundary was established". Some boundaries have survived into the present from a period which antedates the rise of nationalism, while some have come to be established after nationalism has found its territorial expression. Richard Hartshorne is credited to have developed this idea in 1936. He has used the nomenclature which has been derived from physical geography.

Antecedent boundaries are those which were defined and delimited before the main elements of the present-day cultural landscapes began to develop as or those that preceded the development of most of the features of the cultural landscape. As societies developed, they adjusted themselves to the boundary which thus acquired a historical and pragmatic sanction. The boundary between the United States and Canada, established and modified by the treaty agreements between 1782 and 1846, may be said to have been aligned before the development of the cultural landscape on either sides. However, during the period of its definition and demarcation, there were few settlers and some hundreds of nomadic trappers and Indians in the region. It was not wholly unoccupied but the boundary that was established between Canada and Alaska at the time of the agreement in 1825, passed through unsettled/unoccupied and undeveloped territory, and hence, the word 'pioneer' is assigned to it.

Subsequent boundaries are those which were established after the cultural patterns had been formed, and as a general rule, they conform with the cultural pattern. There is a greater degree of conformity with the main cultural features. Boundaries that developed as a part of the President Wilson's paradigm after the First World War in East Europe belonged to this category. Even the boundary across the Patagonian Andes between Chile and Argentina established as a result of the arbitration of King Edward VII in 1902 is a subsequent boundary. It is with the rise of nation-states that subsequent boundary is coming up. The religion-based boundary between India and Pakistan, and the federal linguistic boundaries within India, fall into this category.

Superimposed boundaries were established like subsequent boundaries, after the territory to be divided had been settled and developed, but unlike the latter, they ignore completely the cultural and ethnic characteristics of the area divided. Most of the geometrical boundaries in Africa fall into this category. The boundaries of the Hapsburg empire in 1918 belonged to this category as it cut off Romanians from Romania, Poles from Poland, Serbs from Serbia, and the Italians from Italy.

Superimposed boundaries have come to be developed along truce lines or ceasefire lines. The boundary between the Netherlands and Belgium has been established along the truce line. The 38th parallel between North Korea and South Korea also falls into this category. There is much talk of recognizing the ceasefire line of 1949 between India and Pakistan across Kashmir. If it is really accepted and recognized, it will be a superimposed boundary. Similarly, the line of actual control across Laddakh between India and China also appears to be a superimposed boundary.

Hartshorne used the term 'entrenched' for the long-existing boundary, arguing that whatever the initial and intended functions of a boundary, it begins to affect the cultural landscape associated with it and ultimately becomes an inextricable part of that landscape.

Relict boundaries are those which have been abandoned for political purposes but which, nevertheless, remain 'discernible' in the cultural maps. Relict boundaries can be determined with the help of the presence of the former architecture of buildings. The former Russo-German boundary in Upper Silesia can be identified with the help of the architecture of buildings which differed from one another in the two empires. A number of examples of relict boundaries can be found in Europe and Asia where the empires have disappeared but their iconographies still persist. Apart from morphological classification and functional or genetic classification for boundaries, John Nystuen in 1966 has offered another classification for boundaries in terms of their impact on activities:

Absorbing boundaries are those which tend to absorb energy touching them and hence are characterized by a reduction in the density of activities they contain within the domain.

Reflecting boundaries are those which tend to contain activities by turning them back into the domain. The direction of movement is changed but the energy is not diminished.

Permeable boundaries are those which contrast with the impermeability of the first two types in that part of the energy reaching them passes through in some filtered and/or screened manner. The remainder is either absorbed or reflected.

Though the classification does not seem to have been specifically formulated for political boundaries, nevertheless, the classification adds to our understanding of these phenomena. By this classification, John Nystuen was able to define three types of processes involved with boundary interaction: crossing, contained, and boundary-dwelling.

Theoretically, he tried to discuss a boundary's 'transfer potential' and 'unit permeability'.

One of the pertinent questions "what boundary is best?" The answer to this question has changed over a period of time. In the nineteenth century and also in the early part of the present century when the international relations were governed by the dynamism of the balance of power, it was the strategic boundary along any of the conspicuous features such as mountains, crests and watersheds which was considered to be the best, as it afforded defence and tended to foil invasion. Attempts were usually made to acquire militarily defensive boundaries.

However, the defensive nature of boundary declined/ diminished to a greater extent on account of: (i) technological and scientific innovations, and (ii) collapse of the territorial states and the rise of nation-states. In a changed scenario from empire to nation-state, the national boundary that follows the ethnic patterns was conceived of as the best boundary as it was expressive of the national identity. But soon its inherent weaknesses became apparent as its alignment was found to have disrupted centuries' old economic and social tradition, and infrastructure, accompanied by mass exodus of population. The alignment of the Radcliffe Award on the basis of religious cleavage across the Indus basin and the Ganga basin, caused widespread disruption of infrastructure in the respective regions. That boundary now seems to be best boundary whose definition and delimitation, as well as demarcation is based more on technical and economic considerations, rather than on military and ethnic considerations.

Differentiation

On the basis of the above discussions, and what Kristof and Moodie have done, frontiers and boundaries can be distinguished as under :

a. Frontiers are 'outer-oriented', simply because they lie at a greater distance from the political acumen, and have very little or practically no relation with the acumen, hence its main attention is carried outward towards the peripheral areas. But the boundaries are 'inner-oriented' since they reflect the territorial limit of the sovereignty, which is done by the governments concerned.

b. On account of its peripheral orientation, and thinly inhabited by the people, who are from from every point of view, inferior to the people of the acumen, the frontier becomes manifestation of centrifugal forces whereas the boundary that of centripetal one, because it reflects the state idea vis-a-vis the *raison d'etre* of the state.

c. A frontier is an integrating factor between states on either side as it offers excellent opportunity of movement of different communities across it, facilitating mutual understanding between them. The western frontier of the British *raj* had offered excellent opportunity of mutual contact between the Hindus and Muslim who settled down there. But the alignment of boundary separated and disrupted them. Hence, it is said that "a boundary...is a separating factor."

d. In their origin, the frontier is neither a manifestation of a legal concept or political concept, rather it is a reflection of the spontaneous tendency for the growth of the acumen. But, the boundary is purely a legal concept, and expressive of the jural law.

e. Frontiers are transitional between geographical regions rather than between states. Hence, they are natural and geographical, whereas boundaries, separating the limit of sovereignties between states, are purely political in origin and functions.

f. On account of being natural, the frontiers are areal, expressive of wide extent and transitional functions, whereas boundaries are linear in character, as they are artificially defined, delimited and demarcated by people.

g. With the growth of civilizations and acumen, the frontiers have disappeared, and they have been replaced by boundaries. Therefore, the frontiers are a phenomenon of the past and boundaries are a phenomenon of the present, as more and more states are coming up.

h. Lastly, frontiers being expressive of spontaneous growth of ecumenes remain *in situ* regardless of their character and function. Boundaries are a changing phenomenon and highly movable. With every shift in the balance of power, subsequent to the creation of states, the location of boundary lines continues to change and move.

On the contemporary world map boundaries are the norm. The earth has been, more or less, accurately surveyed and precise lines delimit the territories of states. This is a recent development; prior to the twentieth century maps of most parts of the world showed huge tracts of unclaimed land. Indeed such land on the frontier was generally regarded as a necessary 'safety valve' for accommodating the populations of fast growing states. The role of frontier as a safety valve for future growth is still a widely held view.

However, in practice, boundaries are much less permanent than they appear on a map; they are temporal—the outer line of a state as it exists today constantly changing and constantly adjusting. Frequently, some place beyond the legal limits of the state there exists a line of some type that the state feels is the extreme limit of its national concern.

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