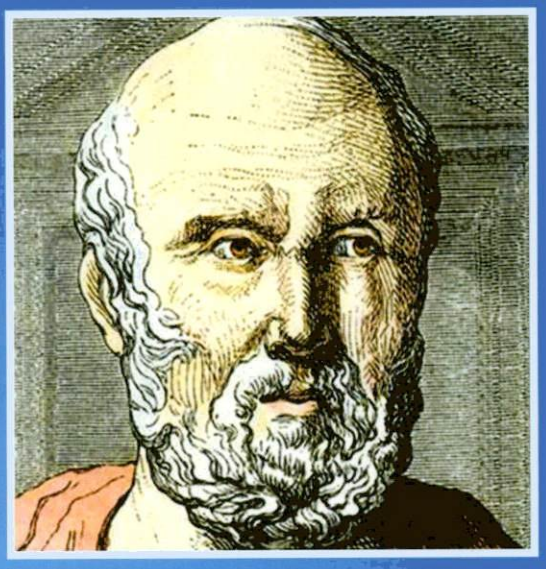
Karnataka State Open University

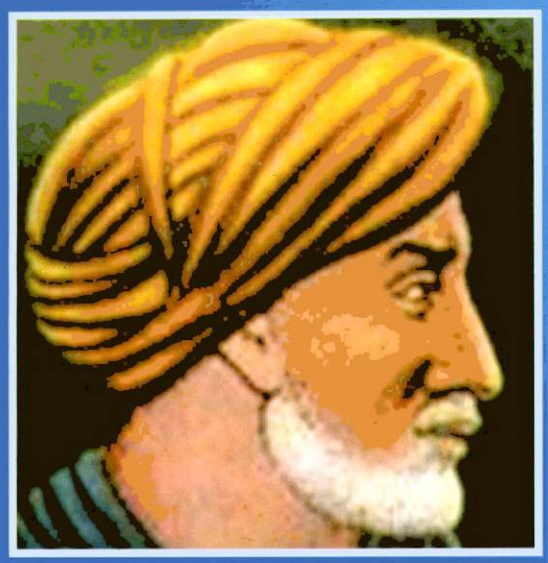
Department Of Studies In Geography

Manasagangotri, Mysore - 570 006

M.Sc. GEOGRAPHY

Second Semester





DEVELOPMENTS OF GEOGRAPHICAL THOUGHT

COURSE - 204 **BLOCK - 1,2,3 and 4**

ಕರಾಮುವಿ

ರಾಷ್ಟ್ರೀಯ ಅಂತಾರಾಷ್ಟ್ರೀಯ ಮಾನ್ಯತೆ

- ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾನಿಲಯವು ಜೂನ್ ೧, ೧೯೯೬ ರಂದು ಸರ್ಕಾರಿ ಅದೇಶ ಸಂಖ್ಯೆ : ED1/UOV/dated 12th February 1996 (Karnataka State Open University Act - 1992) ರ ಪ್ರಕಾರ ಕರ್ನಾಟಕ ರಾಜ್ಯಪಾಲರ ಅನುಮೋದನೆಯೊಂದಿಗೆ ಪೂರ್ಣಪ್ರಮಾಣದ ವಿಶ್ವವಿದ್ಯಾನಿಲಯವಾಗಿ ಸ್ಥಾಪನೆಗೊಂಡಿತು. ರಾಜ್ಯದ ಶೈಕ್ಷಣಿಕ ಪದ್ಧತಿಯಲ್ಲಿ 'ದೂರ ಶಿಕ್ಷಣ ಪದ್ಧತಿ'ಯನ್ನು ಆರಂಭಿಸುವ ಮತ್ತು ಉತ್ತೇಜಿಸುವ ದೃಷ್ಟಿಯಿಂದ ಈ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾನಿಲಯವನ್ನು ಅಧಿನಿಯಮದ ಮೂಲಕ ಸ್ಥಾಪಿಸಲಾಯಿತು.
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Karnataka State Open University
Manasa Gangotri Mysore - 570 006

M.Sc
SECOND SEMESTER
GEOGRAPHY
COURSE - 204

DEVELOPMENTS OF GEOGRAPHICAL THOUGHT - 204

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DEVELOPMENTS OF GEOGRAPHICAL THOUGHT

COURSE INTRODUCTION

Block 1,2,3, and 4

Geography obviously changed over time in terms both of its methodological and its conceptual a commitments. There are different ways in which we can approach this histories. Geographic thought can also be situated geographically, we can think, for example in terms of different geographically, based schools of thought the French school, the Iowa school, the German landscape school, the Berkeley school etc.

First block introduces you to an important contributors to Geography and this block divided into Unit1 contribution of Greek Geographers for the development of Geography. Unit 2 Roman contribution to Geography. Unit 3 discusses the medieval period of Arabs contributions and lastly Unit 4 gives you knowledge about contribution of Indian Geographers for the development of Geography.

Second block study of modern Geography divided into Unit 5 impact of Geographical discoveries. Unit 6 contribution of Verenius and Kant in modern Geography. Unit 7 Alexender Von Hombolt and Ritter contribution and Unit 8 light on German school of thought.

Third block discusses on mainly school of thought. Unit 9 French school of thought Unit 10 British school of thought Unit11 American school of thought and Unit 12 discusses on dualism and dichotomy, general and particular of systematic.

Fourth block discusses on in Unit 13 recent trends in Geography, quantitative revolution in Geography. Unit 14 paradigms in Geography, Unit 15 gives knowledge about models in Geography-Behavioural approach in Geography. Lastly Unit 16 discusses on application remote sensing and GIS.

UNIT : 1 CONTRIBUTION OF GREEK GEOGRAPHERS FOR THE DEVELOPMENT OF GEOGRAPHY

Structure

1.0 OBJECTIVES

After studying you this unit, you will be able to

- examine the idea about the shape and size of the earth.
- study the early assumptions of the continents and oceans.
- study the growth and development in the art of mapping.

1.1 INTRODUCTION

Humanity has always been interested in the Earth. During very early times this interest was limited, naturally, to the immediate vicinity of home and residency, and the fact that we live on a near spherical globe may or may not have been apparent. As humanity developed, so did its interest in understanding and mapping the size, shape, and composition of the Earth.

Greek philosophers were masters of physics, astronomy, mathematics, geography, cartography, and had vast information about the world around them. The geographical diversities, location and site situation of Greece made it possible to these philosophers to enrich huge enormously to geographers. Some of the important contributions to geography has come from the works of Anaximander, Hecateus, Hipparchus, Eratosthenes, and Herodotus.

1.2 ANAXIMANDER OF MILETUS

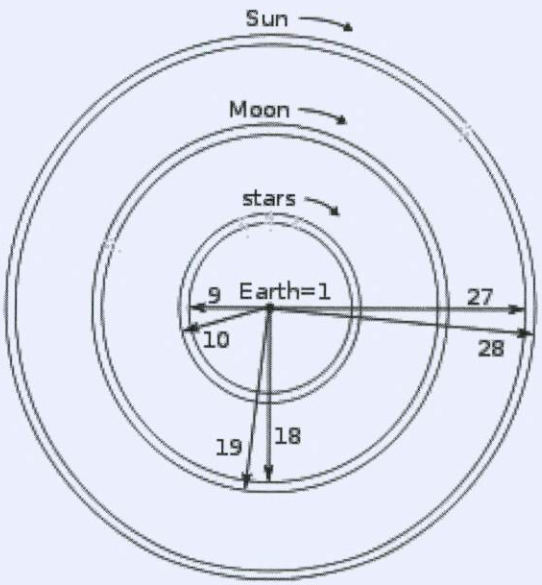
Anaximander; (610 –546 BC) lived in Miletus, a city in modern Turkey. He learned the teachings of his master Thales. Anaximander was one of the earliest Greek thinkers at the start of the Axial Age, the period from approximately 700 BC to 200 BC, during which similarly revolutionary thinking appeared in China, India, Iran, the Near East, and Ancient Greece. He was an early proponent of science and tried to observe and explain different aspects of the universe, with a particular interest in its origins, claiming that nature is ruled by laws. Anaximander's contributions to philosophy relate to many disciplines. In astronomy, he tried to describe the mechanics of celestial bodies in relation to the Earth. In physics, his was the source of a new level of conceptual abstraction. His knowledge of geometry allowed him to introduce the gnomon in Greece. He created a map of the world that contributed greatly to the advancement of geography.

Anaximander's theories were influenced by the Greek mythical tradition, and by some ideas of Thales – the father of philosophy – as well as by observations made by older civilizations in the East (especially by the Babylonian astrologists). All these were elaborated

rationally. In his desire to find some universal principle, he assumed traditional religion the existence of a cosmic order and in elaborating his ideas on this he used the old mythical ideas which ascribed divine control to various spheres of reality. This was a common practice for the Greek philosophers in a society which saw gods everywhere; therefore they could fit their ideas into a tolerably elastic system.

His basic elements of nature (water, air, fire, earth) which the first Greek philosophers believed that constituted the universe. Their collision produced cosmic harmony. In the old cosmogonies The same *rational* way of thought led him to introduce the abstract apeiron (indefinite, infinite, boundless, unlimited[13]) as an origin of the universe.

1.2.1 Cosmology



Map of Anaximander's universe

His major contribution to history was writing the oldest prose document about the Universe and the origins of life; for this he is often called the "Father of Cosmology" and founder of astronomy. Anaximander was the first to conceive a mechanical model of the world. In his model, the Earth floats very still in the centre of the infinite, not supported by anything. It remains "in the same place because of its indifference", The flat top forms the inhabited world, which is surrounded by a circular oceanic mass.

Anaximander was the first astronomer to consider the Sun as a huge mass, and consequently, to realize how far from Earth it might be, and the first to present a system where the celestial bodies turned at different distances. He built a celestial sphere. This invention undoubtedly made him the first to realize the obliquity of the Zodiac. It is a little early to use the term ecliptic, but his knowledge and work on astronomy confirm that he must have observed the inclination of the celestial sphere in relation to the plane of the Earth to explain the seasons.

1.2.2 Meteorology

Anaximander attributed some phenomena, such as thunder and lightning, to the intervention of elements, rather than to divine causes. In his system, thunder results from the shock of clouds hitting each other; the loudness of the sound is proportionate with that of the shock. Thunder without lightning is the result of the wind being too weak to emit any flame, but strong enough to produce a sound. A flash of lightning without thunder is a jolt of the air that disperses and falls, allowing a less active fire to break free. Thunderbolts are the result of a thicker and more violent air flow.

Anaximander's world map

Both Strabo and Agathemerus (later Greek geographers) claim that, according to the geographer Eratosthenes, Anaximander was the first to publish a map of the world. The map probably inspired the Greek historian Hecataeus of Miletus to draw a more accurate version. Anaximander's innovation was to represent the entire inhabited land known to the ancient Greeks. Anaximander most likely drew this map for three reasons. First, it could be used to improve navigation and trade between Miletus's colonies and other colonies around the Mediterranean Sea and Black Sea. Second, Thales would probably have found it easier to

convince the Ionian city-states to join in a federation in order to push the Median threat away if he possessed such a tool. Finally, the philosophical idea of a global representation of the world simply for the sake of knowledge was reason enough to design one.

Being aware of the sea's convexity, he may have designed his map on a slightly rounded metal surface. The Aegean Sea was near the map's centre and enclosed by three continents, themselves located in the middle of the ocean and isolated like islands by sea and rivers. Europe was bordered on the south by the Mediterranean Sea and was separated from Asia by the Black Sea, the Lake Maeotis, and, further east, either by the Phasis River (now called the Rioni) or the Tanais. The Nile flowed south into the ocean, separating Libya (which was the name for the part of the then-known African continent) from Asia.

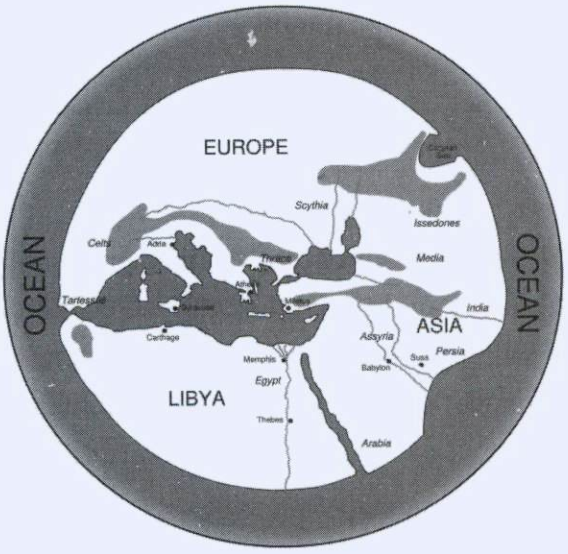
1.3 HECATAEUS OF MILETUS

Hecateus of Miletus (550-490 B.C): Greek geographer and researcher, designer of a world map and author of a book on chronology. Greek philosophers had novel ideas, which were not based on tradition but on rational thought and empiricism. People like Thales of Miletus, Anaximander of Miletus, are usually called the first philosophers. Perhaps they were not completely original (some of their ideas have Babylonian parallels, and they may indeed have learned something in the east), but their critical attitude makes them the founders of western science.

Hecateus of Miletus was born in the great city of Miletus, probably somewhere between 560 and 550 BC. The Greek geographer Strabo of Amasia called Hecateus a student of Anaximander and that the philosopher has influenced Hecateus' ideas about cosmogony (the birth of the universe) and the shape of the world. We know hardly anything about Hecateus' life, although he seems to have traveled to countries like Egypt. We come to know about Hecateus from the work of Herodotus is his Histories.

Hecateus best-known work is his ***World map***, which was based on a map that had been designed by Anaximander. The world map of Hecateus' is described by Herodotus that, the map is divided into three portions (Europe, Asia, Africa), by the Mediterranean, the Red and the Black Seas. At the same time, the map shows a division in four quadrants: western Africa is separated from eastern Africa and the Near East by the Nile; the Near East from Europe by the Black Sea and Caucasus; and Europe is divided in an eastern and western half by the Don. There are more indications that Hecateus' map was extremely schematic - although less schematic than Anaximander's map had been. Hecateus' map was a great advance, because he understood the relative positions of the continents. The map can be seen as a synopsis of Hecateus' ***Description of the earth*** (*Periodos ges*).

Ges periodos the description of earth is a monumental work of Hectaeus written in two volumes, called 'Europe' and 'Asia', the author described the coasts of the Mediterranean Sea - in the first part from west to east, and in the second volume from east to west, including the African coast. The surviving fragments show that his prose was clear and unadorned, and that the author was interested in towns, distances, rivers, mountains, nations, tribes, and boundaries. Customs, animal life, flora, scenery, mythology, and the stories about the foundation of a town were not ignored. On the other hand, historical information seems to have been almost absent.



World map of Hecataeus of Miletus

1.4 HERODOTUS OF HALICARNASSUS

Herodotus was born in 484 BC. He began his writing career as a traveling geographer. Somewhere along these travels, in about 440 BC, Herodotus decides to begin a series of "investigations" which would become to be known as 'The Histories.".

Not satisfied with merely archiving the writings and oral traditions of others, Herodotus applied skeptical inquiry techniques into his interrogations of the past. His method consisted of examining written records of past events as well as supporting documents. He examined the actual geography of an area to determine if it matched up to descriptions. He compared multiple sources of evidence, then, based on his examinations, he would decide whether or not to accept or reject the evidence. He makes a conscious effort to attribute events to human motivations and natural occurrences at level not seen before. "Herodotus ultimately was called." The father of history.

1.4.1 Herodotus' travels:

Herodotus was a great traveler and his contribution to geography is highly remarkable as he wrote after making personal observation during many years of travels.

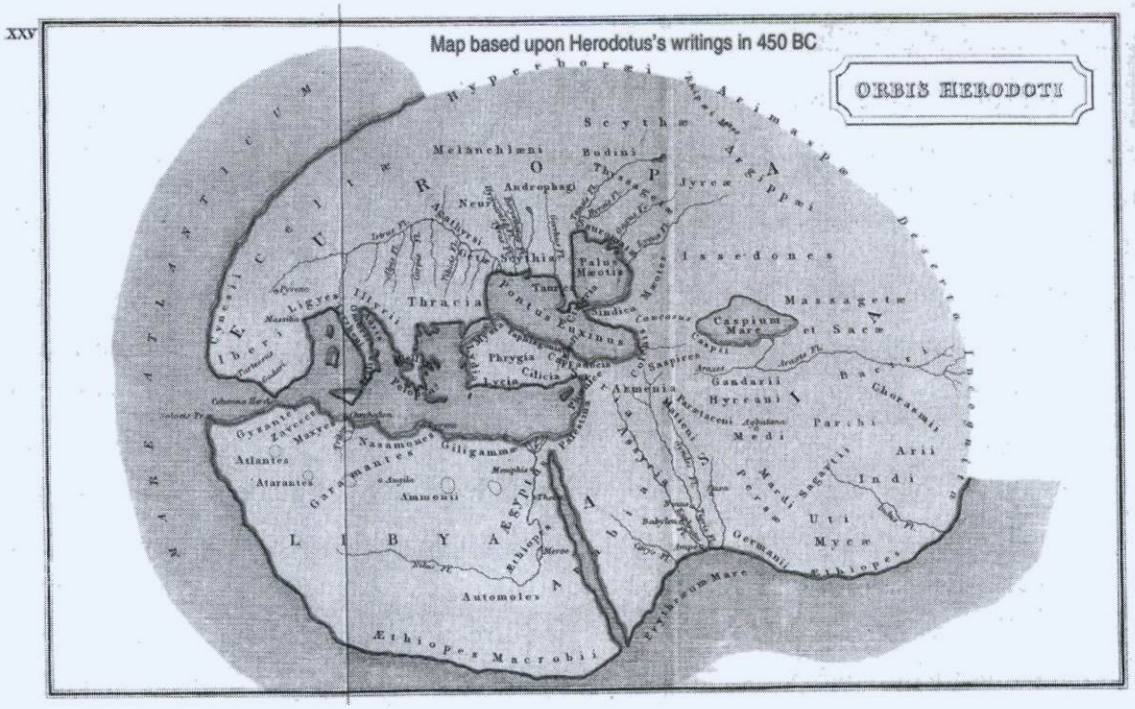
Westward he travelled to Italy and through the strait of Marmara and Bosporus (turkey) reached the Euxine Sea (Black sea). Traversing the Euxine he reached Persian Empire, and stayed at Susa and Babylon. More over he was quite familiar with the coasts of Asia Minor, as also with the islands of the Aegean, the main land of Greece, Byzantium, and the neighboring shores of Thrace,. He made voyage to Tyre. The land of Colchis was also visited by him towards the south he travelled he travelled several times to Egypt and ascended most probably up to the Aswan and in Libya, he reached uptil Cyrene.

1.4.2 Shape of the earth :

Herodotus view about the shape of the earth was not in conformity with those of Hecateus, as a circular plane, and surrounded by an ocean stream. He belonged to the Pythagorean School of philosophy and thus tried to establish a symmetrical correspondence in the distribution of land. He believed that the northern and southern portions of the earth have a perfect symmetry in the pattern of rivers, their source, direction and course especially with respect to the Ister (Danube) and Nile rivers. His knowledge of the source and upper course of the Nile was highly erroneous. He was believed that when there were inhabitants on the back of the northerly winds (Bores), there should also be tribes on the back of the southern winds. The land, according to him, is divided into two equal parts, one lying to the north of the line passing through Hellespont, the Euxine, on the Caucasus Mountains and the Caspian Sea. Thus, Europe was taken to be equivalent to Asia and Libya (Africa) combined. About the Nile River, he stated that it flowed in a direction from west to east, dividing Libya through the middle into two parts. The source of the Nile was in the west of Libya, almost the same distance as that of Ister in the city of Pyrene. Ister, according to him, flowed through the whole of Europe and before discharging its water into the Euxine Sea, adopted a north-south course like the Nile River. Egypt, according to him, lay almost exactly opposite the mountain portion of Cilicia (Turkey) and the peninsula of Sinope, Cilicia (turkey) lay opposite to the place where the Ister fell into the Black sea. It was a crude manner of drawing a meridian from the mouth of Nile to that of Ister. The primitive cosmic beliefs of Herodotus were highly erroneous. He believed that the sun was driven southward out of its regular course by the winds at the approach of winter in spite of all such unscientific beliefs; he was the first scholar who tried to draw a meridian on the world map. The meridian was drawn

from Egypt to Cilicia (south coast of turkey), peninsula of Sinope and the mouth of Ister (Danube). In his opinion, all these fell in a north south line, which could be taken as the meridian.

So far as the spread of continents is concerned Herodotus did not have a clear idea and could not fix the northern limit of Europe. He also did not have any idea of the existence of the north – eastern seas. On the southern side, he felt that the ocean sprawled continuously from the coast of India to that of the Spain. In support of his conviction, he asserted that Scylax had sailed from the mouth of Indus to the red Sea, and Nacho voyaged from Egypt to explore



the coast of Africa and succeeded in reaching the pillars of Hercules by the southern side. He was familiar with the Arabian Sea, the Indian Ocean and the Atlantic Ocean and believed in only two inland seas, one stretching northward and the second eastward from the Indian Ocean and the Atlantic Ocean respectively, i.e., Red sea (Arabian Gulf) and the Mediterranean Sea. He was ignorant of the Persian Gulf.

So far as the Euxine (black sea) is concerned, he had himself navigated in it. In fact, the Greek traders were quiet active in the black sea. His knowledge of the Euxine and the land and tribes lying to the north of it was more correct as compared to his predecessors. He wrote that the Euxine, "the most wonderful of all seas', is 1100 stadia in length (110 miles) in length at the widest portion it is 1,300 stadia or 130 miles. His idea of the size and dimensions of Palus-Maeotis, the mother of the Euxine (sea of Azove), was however, erroneous,. In reality the Sea of Azov is not much more than one twelfth of the size of black sea (Euxine). The supporters of Herodotus feel that the Sea of Azov is a shallow one and might have shrunk in the last two and a half thousand years or so. According to geologists, the Don River is pushing its delta into the sea of Azove. Even making allowance for the silting of the Palus Maeotis, its sprawl is greatly exaggerated. Herodotus showed the Palus Maeotis in a north-south direction drawing a boundary between Europe and Scythia which is also not correct.

Herodotus is the first geographer who regarded the Caspian as an inland sea, whereas Hecateus and his contemporaries as well as all the geographers of Alexandrian era considered it as an arm of the northern ocean. In respect of to Caspian, it is remarkable that Herodotus was in advance of almost all his successors.

1.4.3 Geomorphology and physical geography :

Herodotus was well aware of some of the physical processes that transform the surface of the earth. He insisted that the Nile valley, especially its delta, has been built by silt and mud brought down by the river from Ethiopia. This mud is black in color which can be ploughed easily. Furthermore, he supports the hypothesis that the Nile mud deposited into the Mediterranean Sea had built the delta. He reconstructed the ancient shoreline and showed that many sea ports were not far inland. He explained the process of delta making and stressed the point that the delta of Meander River (west turkey) was also the result of river deposition. Similarly, he tried to establish a relationship between temperature and the movement of winds.

The Borysthenes is considered by Herodotus as the largest river of Scythia after the Danube. Its plain was regarded as the most productive in the world excepting the Nile valley. The inhabitants of this region were called the prosperous. Tanais (Don) is another river mentioned by Herodotus. Thus, the knowledge of Herodotus about the Scythian rivers was appreciably good. But, as he recedes from the coast, his information becomes vague and untrustworthy.

1.4.4 Human and cultural geography :

Herodotus had good information about the kind of people living in the Scythian region (region north of black sea and east of the Caucasus mountains). He was familiar with regard to their customs, traditions and economy of the people in that region. He has divided into several tribes. Characterized by some differences in heir modes of life and habits, these tribes were spread in different geographical locations. He held that the tribes dependent on agriculture dwelt in the valley of Borysthenes; towards the east the area was occupied by nomads and along the coast of Palus Maeotis (Sea of Azov) lived the royal tribe. Among the other tribes Agysthrsi, Neuri, Androphagi, Melanchalaenis, Geloni, Budini and Sauromatae were prominent. All these tribes had their own separate rulers, and were in the opinion of Herodotus, distinct from the Scythians. Agythrsi people were considered the most refined among them, they wore gold ornaments. The Neuris resembled Scythians in manners but were said to have the peculiar power of transforming themselves for a few Androphagi (cannibals). Their manners in all respects were most rude and savage and they spoke a language different from Scythians. To the east of the these was the homeland of Melanchalaenis (black cloaks). The Budini have been considered as blue eyed, with red hair, a well built powerful tribe. They were nomads, like their neighbors on both sides, but their land was thickly forested. The Geloni were settled farmers. According to Herodotus, their origin was from Greece having migrated to Scythia. The Argippaens were the last people towards the north. They were the people who lived to the east of Urals. The people living to the east of the Caspian Sea were Issedones and Massagataes.

Herodotus knowledge of Asia was confined mainly to the Persian Empire which sprawled over the whole of western Asia the exception of the Arabian Peninsula from the Erythraean Sea to the Caucasus and the Caspian, and from the coast of the Mediterranean Sea and black sea to the Indus. Beyond these regions his knowledge was vague.

The Persian Empire for the purpose of administration and revenue collection was divided into twenty satrapies or provinces. He was acquainted with these satrapies and their principal tribes, from the Erythraean sea (Arabian sea) towards the Caspian sea he placed four major tribes i.e., Persians, Medes, Saspirians and Colchians.

1.4.5. Regional geography :

Herodotus has described a great deal about the town and cities of the important places of the ancient times especially around the black sea, Adriatic and the meditteranin sea. However his knowledge about the peninsula of Anatolia (turkey) and Asia Minor which was surrounded

by the Greek colonies was very inaccurate. He was not aware of any of the great mountains chains of Asia like Tarus, Elburz, Zagros, Hindukush and the Himalayas'. Nevertheless, he was conversant with the courses of Tigris and Euphrates and their sources in the highlands of Armenia.

Herodotus gave a good account of the royal road, joining the city of Sardis to Susa, this road, according to him, was marked by royal stations at regular intervals. At each station, there were caravan sarais, (rest-houses), this road was about 13,500 stadia or 1,350 miles which is very close to the actual distance between Sardis and Susa..

Herodotus alluded to the Erythraean Sea as situated to the south of Asia, extending from the Arabian Gulf (red sea) to the mouth of the Indus. The account of India and its inhabitants by Herodotus is interesting and instructive. He was not familiar with the fertile Gangetic plain and considered the Indus as flowing in a west east direction. To the east of the Indus there was no tribe and the area as described by Herodotus was a big sandy desert. He was not sure of the eastern limit of Asia and the existence of a sea of the east. So also his knowledge about the northern parts of the continent of Europe was unknown.

1.5 ERATOSTHENES

Eratosthenes of Cyrene (276 BC –195 BC) was a Greek mathematician, geographer, poet, athlete, astronomer, and music theorist. Eratosthenes was born in Cyrene (in modern-day Libya). He studied in Alexandria, and claimed to have also studied for some years in Athens. In 236 BC he was appointed as librarian of the Alexandrian library. He made several important contributions to mathematics and science, and was a good friend to Archimedes. Around 255 BC he invented the armillary sphere. In *On the Circular Motions of the Celestial Bodies*, for which he calculated the Earth's circumference around 240 BC, using knowledge of the angle of elevation of the sun at noon on the summer solstice in Alexandria and on Elephantine Island near Syene (now Aswan, Egypt).

Eratosthenes has been credited for many great contributions and has been recognized for his innovations and intellect. He was the first person to use the word "geography" and invented the discipline of geography as we understand it. He invented a system of latitude and longitude.

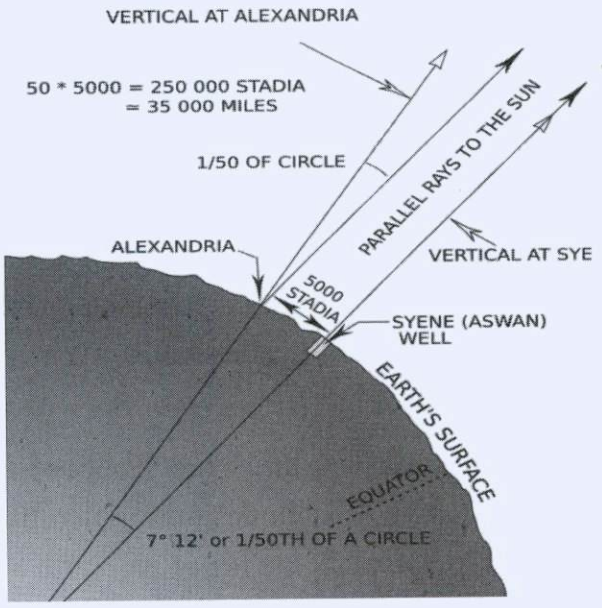
He was the first person to calculate the circumference of the earth by using a measuring system using stades, or the length of stadiums during that time period (with remarkable accuracy). He was the first to calculate the tilt of the Earth's axis (also with remarkable

accuracy). He may also have accurately calculated the distance from the earth to the sun and invented the leap day. He also created the first map of the world incorporating parallels and meridians within his cartographic depictions based on the available geographical knowledge of the era. In addition, Eratosthenes was the founder of scientific chronology; he endeavored to fix the dates of the chief literary and political events from the conquest of Troy. His contemporaries nicknamed him *beta*, from the second letter of the Greek alphabet, because he supposedly proved himself to be the second best in the world in almost every field.

1.5.1 Eratosthenes' method for determining the size of the Earth

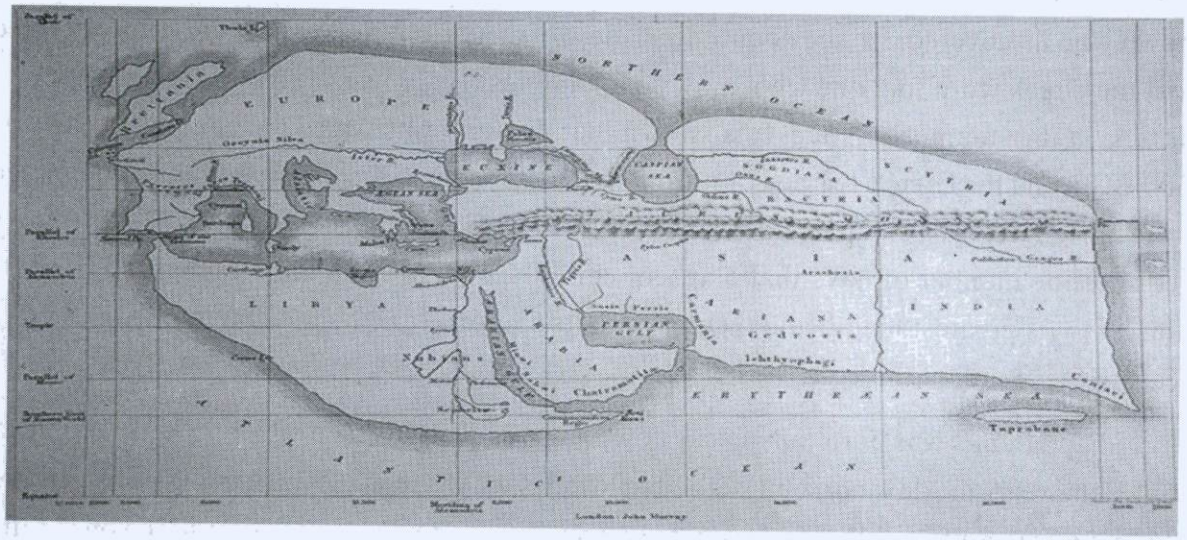
He is said to have made more explicit measurements of the various distances between different locations of places. He had heard that on the longest day of the summer solstice, the midday sun shone to the bottom of a well in the town of Syene (Aswan). At the same time, he observed the sun was not directly overhead at Alexandria; instead, it cast a shadow with the vertical equal to 1/50th of a circle (7° 12'). To these observations, Eratosthenes applied certain "known" facts (1) that on the day of the summer solstice, the midday sun was directly over the Tropic of Cancer; (2) Syene was on this tropic; (3) Alexandria and Syene lay on a direct north-south line; (4) The sun was a relatively long way away (Astronomical_unit). Legend has it that he had someone walk from Alexandria to Syene to measure the distance, that came out to be equal to 5000 stadia or (at the usual Hellenic 185 meters per stadion) about 925 kilometres.

ERATOSTHENES METHOD FOR DETERMINING THE SIZE OF THE EARTH



From these observations, measurements, and/or "known" facts, Eratosthenes concluded that, since the angular deviation of the sun from the vertical direction at Alexandria was also the angle of the subtended arc, the linear distance between Alexandria and Syene was 1/50 of the circumference of the Earth which thus must be 50×5000 = 250,000 stadia or probably 25,000 geographical miles. The circumference of the Earth is 24,902 miles (40,075.16 km). Over the poles it is more precisely 40,008 km or 24,860 statute miles. The actual unit of measure used by Eratosthenes was the stadion. No one knows for sure what his stadion equals in modern units, but some say that it was the Hellenic 185-meter stadion.

Had the experiment been carried out as described, it would not be remarkable if it agreed with actuality. What is remarkable is that the result was probably about one sixth too high. His measurements were subject to several inaccuracies: (1) though at the summer solstice the noon sun is overhead at the Tropic of Cancer, Syene was not exactly on the tropic (which was at 23° 43' latitude in that day) but about 22 geographical miles to the north; (2) the difference of latitude between Alexandria (31.2 degrees north latitude) and Syene (24.1 degrees) is really 7.1 degrees rather than the perhaps rounded (1/50 of a circle) value of 7° 12' that Eratosthenes used; (4) the actual solstice zenith distance of the noon sun at Alexandria was 31° 12' - 23° 43' = 7° 29' or about 1/48 of a circle not 1/50 = 7° 12', an error closely consistent with use of a vertical gnomon which fixes not the sun's center but the solar upper limb 16' higher; (5) the most importantly flawed element, whether he measured or adopted it, was the latitudinal distance from Alexandria to Syene (or the true Tropic somewhat further south) which he appears to have overestimated by a factor that relates to most of the error in his resulting circumference of the earth.



19th century reconstruction of Eratosthenes' map of the known world, 194 BC

1.6 HIPPARCHUS

Hipparchus (c. 190 BCE – c. 120 BCE) was a Greek astronomer, geographer, and mathematician. The appearance of a nova in the constellation Scorpius inspired him to investigate how stars are born and die. With only the power of his eyes, he created the first accurate star map, a catalogue of 1,080 stars, giving their position and relative brightness. In comparing his chart with one compiled by Timocharis and Aristyllus of Alexandria 150 years earlier, Hipparchus discovered that the earth's axis is *precessing,* or wobbling, slowly like a top. His calculation of the inclination of the ecliptic, its equation, and his estimate of the annual precession of the equinoxes were all remarkably accurate. He determined the perigee and mean motion of the sun and of the moon, and he calculated the extent of the shifting of the plane of the Moon's motion. Hipparchus' star catalogue was used for over 1600 years, and his system of star magnitudes is still in use. His main contribution to geography was in applying rigorous mathematical principles in determining the location of places on the earth's surface, being the first to do so by specifying a position's latitude and longitude. In the *Almagest*, Ptolemy made use of a catalogue of stars, whose position Hipparchus had fixed by calculating celestial angular measurements, corresponding to latitude and longitude on earth. Recognizing that the earth was round, he constructed the first globe and was the first to divide a circle into 360 degrees. Hipparchus invented an improved type of astrolabe, which he used to determine accurately the celestial coordinates of stars and a planisphere that allowed stereographic projections (also invented by Hipparchus), making it possible to tell time at night from stellar projections. He calculated the length of the year as 365.24667 days, correct to within 6.5 minutes and by making observations of eclipses, found the distance to the Moon. It isn't known who discovered that the noontime shadow of an upright rod (called a *gnomon,* derived from the Greek word for "one who knows or examines") is longest at the winter solstice and shortest at the summer solstice. It is known that the Egyptians used the sundial as early as 1500 BCE, and the Greeks learned of it from the Babylonians. The L-shaped figure comprised of the upright rod of a sundial and its shadow is often referred to as a gnomon. By keeping a record of the number of days that elapsed while the shadow of a gnomon passed from its shortest to its greatest length and then back to its shortest length, ancient people learned to measure the length of the year.

Hipparchus was born in Nicaea (now Iznik) in Bithynia (now Turkey). He probably spent some years in Alexandria but settled in Rhodes where he made most of his observations. What set him apart from other ancient astronomers was that he collected data based on careful

observations and then formed theories to fit the observed facts. All of Hipparchus works are lost. Most of what is known about him comes from the writings of Strabo and Ptolemy's *Almagest,* written in the 2nd century CE, which was based on Hipparchus' findings. Hipparchus' contributions to astronomy were the most important before the time of Copernicus in the early sixteenth century.

Most scientific historians credit Hipparchus with founding trigonometry. The word is derived from two Greek words, *trigonum,* meaning "triangle," and *metron*, meaning, "measure," combining to mean "measurement of triangles." In ancient times there was no name for trigonometry, which was not considered a branch of mathematics, merely a collection of techniques and formulas ancillary to astronomy. Hipparchus introduced trigonometric functions in the form of a table of chord arcs used to solve the problem of the computation of specific positions from geometric models. This table is practically the same as that of natural sines. It is likely that he had some means of solving triangles in spherical trigonometry. It is also suspected that Ptolemy's Theorem, which gives the necessary and sufficient conditions that a convex quadrilateral be inscribable in a circle, is due to Hipparchus. The theorem implicitly gives formulas for the sines and cosines of the sum and difference of angles, from which all trigonometric relations can be deduced.

1.7 LET US SUM UP

The major contribution of Greek geographers during the ancient times were chiefly in the field of astronomy, mathematical geography and map making, and physical geography. The Greek philosophers were genius in mathematics, geometry and astronomy. These basic sciences were applied to speculate on the shape of the earth, size of the earth, and the location of places on the earth, which were attempted to represent on the map. And which they did it with a very high amount of accuracy. The concept of the shape of the earth was perfected by the Aristotle, the circumference of the earth was measured by Eratosthenes. And the location of places on the map was however perfected by Hipparchus especially through his star catalogue. Similarly the knowledge of the physical surrounding was also logically theorized by the Greeks thereby giving rise to a very firm foundation to geography.

1.8 KEY WORDS

Cosmology, mathematical geography, Ges Periodos, celestial bodies, stadia, Almagest,

1.9 QUESTIONS FOR SELF STUDY

1. Explain the major contribution of Greek geographers.
2. Give an account of the method adopted by Eratosthenes in the measurement of the circumference of the earth.
3. Explain the contribution Hipparchus for the development of map making.
4. Give an account of the contribution of Herodotus for the development of cultural geography.
5. Explain critically the importance of Greek contribution to geography for advancedment of modern geographical knowledge.

1.10 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.
2. Fundamentals of geographical thought: Sudeepta Adhikari, Chaitanya publishing house, Allahabad, 1995.

UNIT : 2 ROMAN CONTRIBUTION TO GEOGRAPHY

Structure

2.0 OBJECTIVES

After studying this unit ,you will be able to

- study the progress of geography during the golden age of Roman empire.
- examine the growth and development of regional geography.
- study the progress of map making.

2.1 INTRODUCTION

The chief contributions of the Romans were in the field of mathematical geography, astronomy, map making and regional geography. During this time the popular engagements were in the expansion of roman territories in Europe and other regions in Africa. Owing to their interest in political expansion, and need to control political power, the Romans where ever they extended their power, they appointed a governor and it was obligatory upon these governors to maintain and send detailed information of the socio economic and infrastructural data to the capital headquarters. In their pursuit to consolidate power. This information became the chief sources of information for the development of regional geography during the roman times. Development of astronomy and map making were also the chief outcome of the political requirements. Some of the important contributions during the roman times are:

2.2 SOME IMPORTANT ROMAN GEOGRAPHERS

2.2.1. Pomponius Mela

Pomponius Mela who wrote around AD 43, was the earliest Roman geographer. His short work (De situ orbis libri III.) Except for the geographical parts of Pliny's Historia naturalis (where Mela is cited as an important authority) the De situ orbis.

Little is known of Pomponius Mela except that he was born in southern Spain, AD 45. The date of his writing may be approximately fixed almost certainly that of Claudius in AD 43.

The general views of the *De situ orbis* mainly agree with Greek writers from Eratosthenes to Strabo; the latter was probably unknown to Mela. But Pomponius is unique among ancient geographers in that, after dividing the earth into five zones, of which two only were habitable, he asserts the existence of anticyclones, inhabiting the southern temperate zone inaccessible to the folk of the northern temperate regions from the unbearable heat of

the intervening torrid belt. On the divisions and boundaries of Europe, Asia and Africa, he repeats Eratosthenes; like all classical geographers from Alexander the Great (except Ptolemy) he regards the Caspian Sea as an inlet of the Northern Ocean, corresponding to the Persian and Arabian (Red Sea) gulfs on the south.

His Indian conceptions are inferior to those of some earlier Greek writers; he follows Eratosthenes in supposing that India occupies the south-eastern angle of Asia. He places the Rhipaean Mountains near Scythian Ocean. In Western Europe his knowledge was somewhat in advance of the Greek geographers. He defines the western coast-line of Spain and Gaul and its indentation by the Bay of Biscay more accurately than Eratosthenes or Strabo, his ideas of the British Isles and their position are also clearer than his predecessors. He is the first to name the Orkney Islands, which he defines correctly. Of northern Europe his knowledge was imperfect, but he speaks of a great bay to the north of Germany, among whose many islands was one, "Codanovia," of the Germanic name for Scandinavia.

2.2.2. STRABO

Strabo was born to an affluent family from Amaseia (modern Amasya, Turkey), a city that he said was situated approximately 75 km from the Black Sea. His mother was from Roman Republic, and he was a proponent of Roman imperialism.

Strabo's life was characterized by extensive travels. He journeyed to Egypt and Kush, as far west as coastal Tuscany and as far south as Ethiopia in addition to his travels in Asia Minor and time spent in Rome. He traveled throughout the Mediterranean and Near East, especially for scholarly purposes. He moved to Rome in 44 BC, and stayed there, studying and writing, until at least 31 BC. In 29 BC, he visited the island of Gyaros in the Aegean Sea. Around 25 BC, he sailed up the Nile until reaching Philae, after which point there is little record of his proceedings until 17 AD.

The first of Strabo's major works, *Historical Sketches* (*Historica hypomnemata*), written while he was in Rome (ca. 20 BC), is nearly completely lost. Meant to cover the history of the known world from the conquest of Greece by the Romans.

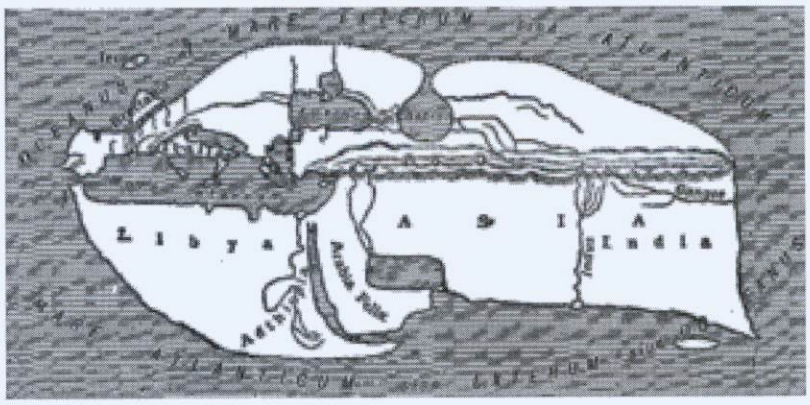
Strabo studied under several prominent teachers of various specialties throughout his early life[7] Around the age of 21, Strabo moved to Rome, where he studied philosophy. In Rome, he also learned grammar, geography and philosophy, a fact obviously significant, considering Strabo's future contributions to the field. He also learnt information of regions of the empire.

Strabo is most famous for his 17-volume work *Geographica*, which presented a descriptive history of people and places from different regions of the world known to his era.

Although Strabo cited the antique Greek astronomers Eratosthenes and Hipparchus, acknowledging their astronomical and mathematical efforts towards geography, he claimed that a descriptive approach was more practical, such that his works were designed for statesmen who were more anthropologically than numerically concerned with the character of countries and regions.

As such, *Geographica* provides a valuable source of information on the ancient world, especially when this information is corroborated by other sources.

Within the books of *Geographica* is a map of Europe (*see image at right*).



Map of the world according to Strabo

Strabo is most famous for his 17-volume work *Geographica*, which presented a descriptive history of people and places from different regions of the world known to his era.

Map of Europe according to Strabo

His geographical work that has come down to us from the classical period, was the most important works ever produced by the scholars of antiquity. The main feature of Strabo's geographical account lies in the fact that it was the first attempt at bringing together all the then known geographical knowledge in the form of general treatise. The criticism that Strabo's geographical treatise is just an improvement over the work of Eratosthenes down not carry much credibility. The work of Eratosthenes was based on just three volumes while Strabo wrote as many as 43 volumes under the title historical memoir. Moreover he wrote 17 volumes of geographical treatise. Strabo is the first scholar who conceived the idea of a complete geographical treatise , comprising all four branches of the discipline, namely, mathematical, physical, political and historical geography. In estimating its importance from a modern point of view, we have to take into consideration not only its intrinsic merits, but also the enormity of the loss which we would have suffered had it perished. It is the one complete treatise on geography and acquaints us with the writings of his predecessors whose works are entirely lost. Their passages re found in the form of quotations in Strabo's works.

Strabo's geographical treatise was designed not for geographers but for politicians and statesmen. In other works, it was meant for general reader and not for mere geographers. The author thus endeavored to present a general picture of each country, the character, physical properties, surface configuration and natural production.

In the field of mathematical geography, Strabo's contribution cannot be termed outstanding when compared with that of his predecessors (Eratosthenes and poisonous). His work was not designed for astronomers and mathematical geographers. Nor was it meant to help them to determine the shape and size of the earth, its relation with heavenly bodies and the important latitudes (equator, tropic of cancer, tropic of Capricorn). Nevertheless, he quotes with approval the assertion of Hipparchus (a leading mathematical geographer) that it was impossible to make an real progress in geography without the determination of latitudes and longitudes. He was of the opinion that for the astronomical and mathematical part of the subject a geographer may content himself with taking for granted the conclusion of physical philosophers and mathematicians. Thus, he assumes that the earth is spherical in shape and situated in the center fo the universe. He also assumes the division of the earth into five zones and the circles upon the sphere – derived from the motion of the celestial bodies, ie., the equator, the zodiac, the tropics and the arctic circle. He saw the earth as an oblong. He regarded Ireland as the most northerly of all the know lands.

In the field of physical geography also, his work cannot be regarded as outstanding but there is no denying the fact that it was a great improvement over this predecessor's works. Unfortunately, strao gave little attention to topographic features, Mountains Rivers and their courses while giving geographical accounts of different regions. Strabo's remarks on physical geography are of great value. He has brought together a large amount of material to throw light on the changes which have occurred over the face of the earth owing to the transgression and regression of the sea, and due to earthquakes and volcanic eruptions. He also discusses the causes which have brought about these changes. The two main principles which he enunciates as his own are mentioned with high praise by Sir Charles Lyell, as being anticipations of the latest conclusions of modern science. These are (1) the importance of drawing inference with regard to the more extensive physical changes from those which take place on a lesser extent under our own eyes, and (2) the theory of alternate elevation and depression of extensive areas.

Strabo's work is mainly historical. Not only does he everywhere introduce the history of a country side by side with its geography, but he also illustrates the one by the other, and endeavors to point out the intimate connection that exist between geography and history. He also attempted to trace the influence of the physical features of an area on the character and history of its inhabitants. To illustrate this point, he wrote that Italy was in a peculiarly protected geographical location and owing to this fact the people of this country are more advanced and developed. The physical location of Italy contributed to the development of power of Rome. He dilates upon the advantages Italy derived from its natural geographical situation. It offered her protection against attacks from outside; its natural harbors gave a boost to its commerce and business activity. Further, Italy's physical location was responsible for its varied and temperate climate as also for the influence of elevation in different parts which caused it to enjoy the products both of a mountainous country and of the plains. It has a beneficial effect upon her water supply, and about all on her central position among the great races of the world. Moreover Strabo gave an artistic treatment to his geographical writings which are not a dry account of facts and places. The main objective of Strabo in his geographical treatise was to present a general survey of the entire habitable world known during that period. Spain, Gaul (France), the coast of the Atlantic, south eastern parts of Britain all these areas were fairly known and thus the Romans opened out all the western parts of Europe up to the river Albis (Elbe), and the region beyond the Danube and the river tyros'. The tracts on the north of Euxine (black sea) and along its eastern coast to the borders of Colchis were plotted in the world map of Strabo. In fact, Mitrhidates and his army generals did enough exploration in

this part of the world. Unfortunately, Strabo did not consult the Greek historian and geographer, Herodotus, who had given a vivid account of the region and tribes situated to the north and east of the Euxine Sea. Herodotus, in the opinion of Strabo, was a retailer of fiction. It is because of this attitude of Strabo towards Herodotus that his knowledge of the Scythian races is qui9te meager and erroneous.

Of the Caspian sea Herodotus has given a corre3ct account d3escribing it as a closed sea but Strabo believed that it communicated with the northern ocean and beyond it the jaxarter remained, as it was in the days of Alexander, the limit of discover. With regard to India, the peninsula of India continued to be unknown, and the Ganges was regarded as flowing into the eastern ocean. Regarding Africa, the upper course of Nile (cinnamon land) was the southernmost limit, as far as Strabo was concerned. He did not describe Maureania and the western coast of Africa though a good account of these regions was given by the Greeks and his own contemporary Juba. He compared the deeds of the roman army with those of Alexander's eastern expedition by saying that the Romans had opened out all the western parts of Europe inn the same manner as the conquest of Alexander had done shortly before the time of Eratosthenes,. It is worthwhile to give a brief account of the contents of the different volumes of Strabo's geographical treatise.

The first two books of his geography are devoted to an introduction of the subject in which he discusses the aims and objectives of his treatise and the fundamental principles on which he conceives the general features which characterize the entire area of the world and the then known continents. These two volumes can be regarded as the most difficult and unsatisfactory part of his work. These volumes comprise a historical review of the progress of geography from the earliest days but the approach is not methodical. In these works, he reviewed the work of Eratosthenes and his other predecessors but most of the time he criticizes the previous attempts of geographers. He, however, appreciates the works of the great greet poet, homer, and considers him as the founder of all geographical knowledge.

In the second book, he examines in detail the work of Eratosthenes, and discusses the various changes introduced by him in the map of the world. He appreciates the work of Eratosthenes in which he gave an account of Asia. In fact, in regard to the whole of Asia, Strabo adopted the map of Eratosthenes with hardly any alteration. It was only about the land lying between the Euxine and the Caspian sea that Strabo had acquired more information than his predecessors, and even this knowledge was of such imperfect character that he believed the Caspian to communicate with the northern ocean. Little or no change was made in the details of Africa, but in the map of Europe, especially its north western parts, he inserted

many new details. About the shape of the inhabited world he followed the view of Eratosthenes who had described it as forming an irregular oblong with tapering extremities towards the east and the west.

The third book gives an account of Europe with stress on the geography of Spain, Gaul and Britain. The description of these areas, Strabo mainly relied on Polybius and poisonous and Ceaser who had travelled to Spain. He refers of the Pyrenees Mountains as forming a continuous chain from bay of Biscay to the Mediterranean sea in the north – south direction which is not correct. Moreover, the considered the sacred promontory to the most westerly point of Europe.

The fourth book is devoted to France, Britain and the Alps. And the fifth and sixth books deal with Italy and Sicily. The seventh book describes the countries extending to the east of Rhine and to the north of Danube. This geographical account is highly defective. His knowledge of central Europe and the land lying to the north of the Euxine was imperfect chiefly because this region was inhabited by barbarians and Strabo did not have reliable information about this region.

The eighth, ninth and tenth books deal with the geography of Greece and its neighboring islands. Whereas the islands and coastal land of the Aegean sea is not correct. The eleventh to sixteenth books are devoted to the geographical descriptions of Asia. In all these books he relied upon Eratosthenes, especially with reference to the configuration, topography and drainage system. He assumed the Taurus Mountains as the dividing line between the northern Asia and the southern Asia. He divided northern Asia into four divisions. (1) Tanais to Caspian Sea, (2) Caspian to Scythians, (3) medians and Armenians, and the last (4) Asia Minor.

The seventh and the last book of Strabo's great work are devoted to Africa where two thirds of the book deals with the geography of Egypt.

From the above description it is clear that Strabo was to only geographer of the ancient period who lucidly wrote about all the branches – historical, political, physical and mathematical of geography.

2.2.3. Ptolemy

Few details of Ptolemy's life are known. He was a Roman citizen, but most scholars conclude that Ptolemy was ethnically Greek, although some suggest he was a Hellenized Egyptian.

His own contribution in the field of geography, especially in mathematical geography, is highly commendable and has been acknowledged throughout the ages. His best-known works are the syntaxes popularly known as the Almagest and the outline of geography. The almagest deals with complicated problems of mathematical geography and astronomy. He believed in a spherical earth, situated in the center of the heaven (universe). His other book the outline of geography was devoted to the exact determination of the position of places by means of latitudes and longitudes.

In the opinion of Ptolemy, geography is a science which deals with the art of map-making. This conception dominates the entire book of Ptolemy. The basic objective of Ptolemy was 'to reform the map of the world' on the basis of astronomical principles. Thus, he followed in the steps of Eratosthenes and Hipparchus who described geography as the science of map making. He was a staunch follower of Hipparchus who stressed that a map of the world could correctly be laid down only by determining the latitudes and longitudes of all the important points on its surface. He was aware of the fact that to achieve satisfactory results, it was necessary that all such positions should be determined by direct astronomical observations. Unfortunately, the numbers of such observations at his command were very less. Thus, he had to rely upon the distances computed by travelers and navigators. These estimates and itineraries of travelers were invariably inaccurate and many a time was highly exaggerated.

Ptolemy wrote eight books, out of which six are almost exclusively devoted to the astronomical tables, latitudes and longitudes of different places.

The major contribution of Ptolemy in the field of mathematical geography can be studied under the sub headings: circumference of the earth, dimensions of the habitable world, prime meridian, graticule and design of projection, and finally, the salient features of his map and geographical account of the major features of the different parts of the world.

With regard to the measurement of the circumference of the earth, he adopted the division of equator and other great circles from Hipparchus, who for the first time, divided circle into 360 degree. He considered every degree equal to 500 stadia (50 miles) instead of 600 stadia (60 geographical miles). Owing to this wrong notion, the error about the circumference of the earth got multiplied. Apart from this, since the travelers and navigators would exaggerate the distances of their travels between different places and since Ptolemy relied on these accounts and itineraries the world map prepared by him got distorted.

Eratosthenes's fundamental parallel extends from sacred promontory (cape St. Vincent) through the strait of Gibraltar and the Rhode Island to the Gulf of Issues was considered by

Ptolemy a latitude to the north of equator corresponding to 36 degree. Ptolemy measured this longitude along this parallel to which was considered the latitude of Rhode. Ptolemy made a mistake in bringing down the island of Sardinia fairly south which is really situated at 39°12' N. This mistake distorted the shape Sicily. The latitude of Massilia (43°5') was however, correctly determined, which was obscure to Strabo.

Ptolemy presumed the fortunate islands (the canaries) as the point through which the prime meridian passed. The western most islands (Ferro) of the Canaries islands continued to be treated as the prime meridian, and is so even among some German geographers of the present day. But in Ptolemy's days the position of those islands was not determined, and thus it was only by conjecture that he placed them two and a half degree both east and west of the Sacred promontory (Cape St. Vincent) instead of nine degree which is the true estimate. The total result which he produced from the length of the known world from the fortunate island in the west of the city of Sera in China towards the east was 180 degree, whereas in reality it is about 130 degree. This mistake proved easy to circumnavigate a shorter distance especially in 14th to 15th century and contributed to the discovery of America by Columbus.

2.3 DEVELOPMENT OF MAJOR BRANCHES OF GEOGRAPHY DURING ROMAN EMPIRE

2.3.1 Map making :

The great contribution made by Ptolemy lies in the great improvements he made over the previously drawn maps. The main objective of Ptolemy was to elucidate his world map and to make mathematical geography perfect and complete.

He was able to do so by adopting projection for the world map showing the graticule of latitudes and longitudes. In fact in regard to the mathematical construction of the projection of his maps, Ptolemy was far ahead of his predecessors. He represented the equator and the latitudes by parallel curves, and the meridians as straight lines bisecting the equator at right angles which converge at a point (pole) situated beyond the limits of the map (habitable world). Subsequently, he reduced the meridians also to a curved form so as to make them correspond more nearly with the reality. The map on which his network of latitudes and longitudes was drawn was not a perfect hemisphere.

2.3.2. Climatic zones :

The climate climatic zones of Ptolemy, also marked on this map, were like those spaces on the surface of the globe to which Hipparchus assigned that name. The width of these

intervals, however, was not measured in degrees, as was the case with climate of Hipparchus, but by the increase in the length of the longest day, proceeding northwards from the equator. From this line as far as 45° N latitude, where the longest day was of fifteen and a half hours, the breadth of a climate (climatic zone) was determined by the difference of a quarter of an hour in the length of the longest day but beyond the 45° N by the difference of half an hour.

2.3.3. Regional geography :

The Roman administration was under an obligation to provide socio economic and administrative information to the Roman government chiefly to facilitate in good governance. In this background the growth of regional geography was possible during the times of Romans and more particularly by Ptolemy.

1. Ptolemy described the regions and nations of Western Europe at length in his second book; he devoted two sections to the geography of the British Isles. Romans, achieved tremendous success in the British Isles, especially in England and whales. The map of the British Isles constructed by Ptolemy with the help of latitudes and longitudes corresponds very closely to the reality in shape.
2. France and Spain : These parts were well known to the Romans. In fact, they constructed many roads through these countries to improve accessibility and provide easy means of transport and communications with north – west Europe and the British isles. Consequently, Ptolemy gave a reliable picture of shape and description of these countries.
3. The trans Rheine region (Germany) was not captured by the roman armies. Consequently, Ptolemy had a distorted and erroneous picture of this region which cannot be taken as an improvement over the works of his predecessors. His knowledge of the supposed islands of Baltic was still more imperfect.
4. He was more accurate of Caspian sea, showing it as an inland sea. Herodotus was the first who propounded this idea, but from the Alexandrian period this concept was discarded. Ptolemy was, however, in error in regard to its shape, supposing its greatest length to be from west to east. Its north south extension has also been reduced, though he was aware that the Volga discharges its water into the Caspian Sea.
5. Ptolemy's knowledge of the coastal region, mountains and islands of the Caspian sea was adequately reliable. Nevertheless, he made mistakes in the plotting of Italy, gulf of Geneva and the sea of Adriatic.

6. Ptolemy described the geography of central Asia on either side of the Altai mountains meticulously. He gave an account of tribe's information concerning the country that adjoin Scythia on the east of the land of china, the eastern most point of the habitable world.

7. Ptolemy also plotted the Gangetic gulf for the first time. He showed the source of the Ganges and its main tributaries in the Himalayas. The general direction of the western coast of India from north to south was correctly conceived and Ceylon was placed opposite to the western coast. Ptolemy had a fairly correct notion of the general shape and outline of Ceylon, but he exaggerated its size and extended it up to 15°south latitude.

8. His information of Trans Gangetic region was vague and obscure. To the east of the bay of Bengal, he places a land called Malaya. Ptolemy believed that the unknown land beyond ultimately joined the unknown parts of the east African coast, making the Indian Ocean a vast island sea. Thus, he predicted the Indian ocean to be surrounded on all sides by land. It was a mere hypothesis, which has also been postulated by Hipparchus.

9. Western coast of Africa was more familiar to the Romans especially due to the fact that their traders were quite familiar with the coast of Mauretania (morocco and Algeria). He described

The world map of Ptolemy revealed exaggerated size of the land hemisphere. The black sea and the Sea of Azov are shown in distorted form. The Caspian Sea is shown as an inland lake. The map shows no connection between south east Asia and Africa, making the Indian ocean a land locked sea/. the construction of such a scientific map on projection in the absence of reliable data and observed information was not an easy task. It was because of this efforts that the new world and the continents of Australia and Antarctica were discovered by the explorers of the 15th and the 18th centuries, after a lapse of more than 13 and 16 hundred years respectively.

2.4 LET US SUM UP

The work of Strabo was basically a historical presentation of geographical information. This describes the knowledge of the entire habitable earth. The enrichment of regional information for the first time was practically realized therefore by the Roman times. Which has Led to the development of regional geography. And the political and economic urge by the expansionist movement by the Romans needed good maps to keep account about the trade routes, places, and physical and geographical information has helped in the growth and development of good scientific maps with perfect coordinate system.

2.5 KEY WORDS

Almagest, outline of geography, geographical Syntaxes, historical sketches, Geographia', Climata, Codanovia

2.6 QUESTIONS FOR SELF STUDY

1. Explain the contribution of Romans in the development of major branches of geography.
2. Explain the contribution of Claudius Ptolemy in the development mathematical geography and cartography and trace the significance of his work in future development.
3. Describe the contributions of Strabo for the development of regional geography.

2.7 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.
2. Fundamentals of geographical thought: Sudeepta Adhikari, Chaitanya publishing house, Allahabad, 1995.

UNIT : 3 MEDIEVAL PERIOD- ARABS CONTRIBUTIONS

Structure

3.0 OBJECTIVES

After Studying this unit you will be able to

- Know the efforts of Various great geographers
- Identity the advancement of Geography, can to graphy and earth sciences in the medieval Islamic Civilization.
- Know the Later developments under Turks, Particular Under the Ottoman Empire

3.1 INTRODUCTION

The prominence of geography among Muslim scholars is perhaps distinct and the fact that the revival of ancient geography can be chiefly attributed to the scholarship of the Arab travelers, historians, and business men. The fact that trade with distant lands demanded accurate maps or descriptions at numerous times every day; millions of Muslims must turn toward Mecca and pray. Sometime during their lifetime, every Muslim must make the *hajj*, a pilgrimage to the holy city of Mecca. These factors have demanded a basic knowledge of geography.

The Muslims' most important contribution to geography was not necessarily technical or scientific, but was in many ways archival—the preservation of the ancient works of the Greeks and the Romans through the dark ages of medieval Europe. Many of the works of Aristotle, Ptolemy, and other famous Greek, Egyptian, and Roman geographers were saved and translated by Muslim scholars.

The center of Islamic learning was Baghdad. Here great translation projects took place, converting the great works of different cultures into Arabic. One of these great projects was started by a man named Calif al-Mamun in 813 AD. He employed people of all races and religions to help translate books from around the world. He also paid each translator the weight of their books in gold. Great libraries and schools thrived on the works that the translators contributed.

Muslim traders had also been traveling as far west as Ireland and as far east as China or even possibly Japan. From these great traveling merchants came a need for maps and details about cities. Many of these traveling merchants kept detailed records of their journeys, sharing their experiences with other merchants or caravans, and sometimes even selling their information. Of all the contributions made to the field of geography by the Muslims during the period between 800 and 1400 AD.

Besides, the growth of knowledge in geography expanded as a result of the facilities received from the libraries in major towns like Baghdad, and other support the travelers received from local people, and the Muslim travelers could travel anywhere in Muslim countries without any restriction. The prevalence of books and their availability at low price greatly helped the growth in the number of publications. And the introduction of paper to the Islamic world by Chinese in 751 and the spread of paper mills in most large towns and cities are some of the important causes of the growth of geography in the medieval times. The introduction of paper coincided with the coming to power of the Abbasid dynasty who gave immense encouragement and patronage for people to acquire knowledge, and there is no doubt that the availability of cheap writing material contributed to the growth of the knowledge postal system and lively intellectual life.

Some of the important areas of contribution of Arabs are in the field of mathematical geography, map projection, and the preparation of the world map with accuracy, regional geography, and historical geography.

3.2 SOME IMPORTANT GEOGRAPHERS IN THE MEDEIVAL TIMES

3.2.1. Al-mas Udi

(born c. 896- 956), was an Arab historian and geographer, known as the "Herodotus of the Arabs."[1] Al-Masudi was one of the first to combine history and scientific geography in a large-scale work; his important book was on world history "*The Meadows of Gold and Mines of Gems*", a world history.

Al-Mas'udi was born in Baghdad. He was associated with many scholars wherever he travelled.

Al-Masudi's travels occupied most of his life even until very close to his end. His journeys took him to most of the Persian provinces, Armenia, Azerbaijan and other regions of the Caspian sea' as well as to Arabia, Syria and Egypt. He also travelled to the Indus valley, and other parts of India, especially the western coast, and he voyaged more than once to east Africa. He also sailed on the Indian ocean, the red sea, the Mediterranean and the Caspian, Sri Lanka and China among his travels. He spent his last years in Syria and Egypt.

We know little for sure about how he supported himself during such extensive travels within and beyond the lands of Islam. He had gathered enormous information from his long years of research and painful efforts of voyages and journeys across the east and the west, and of the various nations that lie beyond the regions of Islam.

Al-Mas'udi was a pupil of prominent intellectuals. In addition he was familiar with the medical work of Galen, with Ptolemaic astronomy, with the geographical work of Marinus and with the studies of Islamic geographers and astronomers.

His wide ranging interest included the Greeks and like all other Arabic historians, he was unclear on Greece before the Macedonian dynasty that produced Alexander the Great. In al-Mas'udi's view the greatest contribution of the Greeks was philosophy. He was aware of the progression of Greek philosophy from the pre-Socratics onward.

Travels in lands beyond Islam :

Al-Mas'udi is distinguished geographers of his time for the extent of his interest in and coverage of the non-Islamic lands and peoples of his day. He also described the geography of many lands beyond the Caliphate, as well as the customs and religious beliefs of many peoples.

His normal inquiries of travelers and extensive reading of previous writers were supplemented in the case of India with his personal experiences in the western part of the subcontinent. He demonstrates a deep understanding of historical change, tracing current conditions to the unfolding of events over generations and centuries. He perceived the significance of interstate relations and of the interaction of Muslims and Hindus in the various states of the indian subcontinent.

His brief portrayal of Southeast Asia stands out for its degree of accuracy and clarity. He surveyed the vast areas inhabited by Turks. He conveyed the great diversity of Turkish peoples, including the distinction between sedentary and nomadic Turks.

He informed the Arabic reader that the Russians are more than traders. They are a diverse and varied collection of people. He noted their independent attitude, the absence of a strong central authority among them, and their paganism. He was very well informed on Russian trade with the Byzantines and on the competence of the Russians in sailing merchant vessels and warships. He was aware that the Black Sea and the Caspian Sea being two separate bodies of water.

Al-Mas'udi's global interest included Africa. He was well aware of peoples in the eastern portion of the continent. He knew less of West Africa, though he names such contemporary states as Zagawa, Kawkaw and Ghana. He described the relations of African states with each other and with Islam. He provided material on the cultures and beliefs of non Islamic Africans.

In general his surviving works reveal an intensely curious mind, a Universalist eagerly acquiring as extensive background of the entire world as possible. The geographical range of his material and the reach of his ever inquiring spirit are truly impressive.

A complete French translation of The Meadows of Gold was published along with arabic many other languages several times.

al-Masudi's work was compared to Herodotus, the ancient Greek historian called "The Father of History." And Pliny.

3.2.2. Abu Rayhan *Al-biruni* (973-1048 Ad) :

Al-Biruni was invited by Mahmud Ghaznavi to study and to initiate the Indian doctrines to the Muslims. For that purpose he came to India and contacted the Indian thinkers. To his other attainments he added the knowledge of Sanskrit and translated some of the Sanskrit treatise into Arabic.

He was a Persian mathematician, astronomer, traveler, and teacher, who studied map projections and, also, Indian literature. He has extensively contributed in the field of mathematical, physical and regional geography. He prepared the latitudes and longitudes of the different places, towns and cities. His measurements of latitudes and longitudes were most exact, and the maps of Iran and Transoxiana prepared on the basis of these observations were most accurate.

He also stated that Agricultural operations and outputs of crops depend on success of summer monsoons. The general physical structure, the culture landscape and the socio-economic institutions of India were also described by him. Almost all the important rivers of India were discussed by him in his book. The major rivers described in Kitab-al-Hind are Ganges, Sindh (Indus), Narmada (Narbada), Kudacarid (Godavari), Jamuna, Irawa (Ravi), Biyatta (Beas), Chandraha (Chenab) and Jailam (Jhelum).

Al-Biruni's greatest contributions to geography were his discoveries in geomorphology and his amazing translation skills. He was from Khwarazm, now present-day Kazakhstan. He was given the title of "The Master" for his accomplishments in geology and geodesy, his translations of Indian works, and his linguistic skills. Some of his works include the study of a system of longitude and coordinates, historical geography, and theories of creation.

Al-Biruni noted many different things about geomorphology and astronomy. He noted that stones were smooth and rounded because of being tumbled around in mountain streams. He discovered that water can change the face of stone by erosion. He noted that alluvial

material that landed close to mountains was coarse in texture, and that the material farther away was much finer in texture. Al-Biruni had suggested that it was almost always night at the south pole, and he mentioned that the Hindus believed that the moon caused the tides.

3.2.3 Ai-idrisi. :

AI-Idrisi was a native of Morocco, and he was educated at the University of Cordoba in Spain, At the invitation of Roger II, the ruler of Sicily, **AI-Idrisi** was asked to send out people to verify and record the locations of uncertain places in order to update navigational records. With the information brought back, Idrisi had compiled a new geography book that corrected many discrepancies. He stayed at Palermo, and completed in 1154 a book with the title 'Amusements for him who desires to Travel around the World'.

He substituted projections by dividing the inhabited world into seven climates or zones between the equatorial line and the arctic region, each of which was further divided into eleven equal parts by perpendicular lines.

Produced his medieval atlas, *Tabula Rogeriana* or *The Recreation for Him Who Wishes to Travel Through the Countries*, in 1154. He incorporated the knowledge of Africa, the Indian Ocean and the Far East gathered by Arab merchants and explorers with the information inherited from the classical geographers to create the most accurate map of the world in pre-modern times. With funding from Roger II of Sicily (1097–1154), al-Idrisi drew on the knowledge collected at the University of Cordoba and paid draftsmen to make journeys and map their routes. The book describes the earth as a sphere with a circumference of 22,900 miles (36,900 km) but maps it in 70 rectangular sections. Notable features include the correct dual sources of the Nile, the coast of Ghana and mentions of Norway. Climate zones were a chief organizational principle. A second and shortened copy from 1192 called *Garden of Joys* is known by scholars as the *Little Idrisi*.

On the work of al-Idrisi, S. P. Scott commented:

"The compilation of Edrisi marks an era in the history of science. Not only is its historical information most interesting and valuable, but its descriptions of many parts of the earth are still authoritative. For three centuries geographers copied his maps without alteration. The relative position of the lakes which form the Nile, as delineated in his work, does not differ greatly from that established by Baker and Stanley more than seven hundred years afterwards, and their number is the same. The mechanical genius of the author was not inferior to his erudition. The celestial and terrestrial planisphere of silver which he constructed for his royal patron was nearly six feet in diameter, and weighed four hundred and fifty pounds; upon the

one side the zodiac and the constellations, upon the other—divided for convenience into segments—the bodies of land and water, with the respective situations of the various countries, were engraved."

Idrisi corrected the idea that the Indian Ocean was enclosed and that the Caspian Sea was a gulf to the world ocean. He corrected the charting of many rivers in Europe and Africa and several major mountain ranges. At Palermo, improvements were made in navigation and the use of coastal charts, and maps were corrected. It has been suggested that these corrections were the spark that set off the age of exploration. His most famous collection of information was known as *The Book of Roger*, written in Arabic but strangely not translated until 1619.

3.2.4. Ibn-batuta, 1304-1368

Born in Tangier into a traditional family of judges, ibn-Batuta was 21 years old when he set out to make a pilgrimage to Mecca and completed his studies in law. On his way to Mecca he became fascinated with the people and places he visited. By the time he reached Mecca, he had decided to devote himself to travel instead of studying law. From that point on, he carefully avoided traveling the same route twice; enabling him to see new routes and places.

Ibn-Batuta traveled all over the Arab peninsula, down the Red Sea, to Ethiopia, and along the east coast of Africa. He confirmed what ibn-Haukal had said about the torrid zone below the equator being populated when he traveled the coast and visited Arab trading markets.

He later traveled east and north to Baghdad, Persia, the Black Sea, the Russian steppes, eventually reaching Bukhara and Samarkand. He received a job from the Mongol emperor in Delhi and traveled through the mountains of Afghanistan. While at his post in Delhi he received the opportunity to travel widely in India.

Ibn-Batuta later was appointed to become the ambassador to China by the Mongol emperor. On his way to China he received the opportunity to see Indonesia, traveling to the Maldive Islands, Ceylon, Sumatra, and finally China.

After spending time in China, ibn-Batuta returned home in 1350. He traveled to Fez, the capitol of Morocco. He made a trip north into Spain, and he later made a trip south across the Sahara to Timbuktu. There he learned about the black Muslim tribes of West Africa.

Upon his return in 1353, he decided to settle in Fez and wrote accounts of his travels by order of the Sultan. He wrote about the many different places he had traveled in his book *Rehla* (Travels). In the book he notes the different climates, peoples, and customs. *Rehla* made little impact on the Christian world. Ibn-Batuta was the most traveled person of his time, traveling an estimated 75,000 miles. He was the last of the great Muslim geographers, giving way to the European age of exploration.

3.2.5. Ibn-khaldun, 1332-1406

Probably best known for his studies in human-environment relations, ibn-Khaldun was a great historian and geographer. Born on the Mediterranean coast of northwest Africa, Khaldun lived in Algeria, Tunisia, Spain, and Egypt. In 1377, he completed his introduction to world history, the *Muqaddimah*. In it, he discussed how humans and the environment interact. He also examined subjects like government, the sciences, cities, and physical geography. Many of his ideas, however, were based on Greek works.

Other Prominent Muslim Geographers

3.2.6. Ibn-haukal (Ibn-hauqal, Mohammed Abul Kassem), 943-969 Ad

Born in Baghdad, the center of learning in his day, ibn Haukal was a traveler who spent much of his time writing about the areas and things he had seen. He spent the last 30 years of his life traveling to remote parts of Asia and Africa. One of his travels brought him 20° south of the equator along the African coast. One of the things he noticed was that there were large numbers of people living in areas that the Greeks said were uninhabitable.

One of his greatest collections of works was a book called *The Description of the Earth* (Configuration de la Terre), which included a detailed description of Muslim-held Spain, Italy, and the "Lands of the Romans," the term used by the Muslim world to describe the Byzantine Empire. His descriptions were accurate and very helpful to travelers.

3.2.7. Ibn-khordadbeh, 820-912 Ad

Ibn-Khordadbeh was the postmaster general of the Abbasid caliphate and an author of many descriptive guides to different regions and cities. He assembled many volumes describing travel routes for merchants, including a book titled *The Book of Roads and Provinces*.

3.3 LET US SUM UP

In the Middle Ages, Muslim scholars continued and advanced on the mapmaking traditions of earlier cultures. Mostly used Ptolemy's methods; but they also took advantage of what explorers and merchants learned in their travels across the Muslim world, from Spain to India to Africa, and beyond in trade relationships with China, and Russia.

The chief contributions of the Arabs can be summed up into cartography and map making, regional geography, historical geography, and map projections.

An important influence in the development of cartography was the patronage of the Abbasid caliph, al-Ma'mun, who reigned from 813 to 833. He commissioned several geographers to remeasure the distance on earth that corresponds to one degree of celestial meridian. Thus his patronage resulted in the refinement of the definition of the mile used by Arabs (*mîl* in Arabic) in comparison to the *stadion* used by Greeks. These efforts also enabled Muslims to calculate the circumference of the earth.

Regional cartography

Islamic regional cartography is usually categorized into three groups: that produced by the "Balkhî school", the type devised by Muhammad al-Idrisi, and the type that are uniquely found in the *Book of curiosities*. The maps by the Balkhî schools were defined by political, not longitudinal boundaries and covered only the Muslim world. The only shapes used in designs were verticals, horizontals, 90-degree angles, and arcs of circles; unnecessary geographical details were eliminated. Al-Idrîsî defined his maps differently. He considered the extent of the known world to be 160° in longitude, and divided the region into ten parts, each 16° wide. In terms of latitude, he portioned the known world into seven 'climes', determined by the length of the longest day. In his maps, many dominant geographical features can be found.

Historical geography: the Arabs are credited to discover all the lost geographical documents which were destroyed at the time of the dark ages. They brought back to the world all the Greek, or the Roman geographical account with an earnest lust for knowledge they translated into Arabic and they continued to do more advancement in the field of map making and map projection. In fact their knowledge had grown so much that Al-Khwârizmî, Al-Ma'mun's most famous geographer, corrected Ptolemy's gross overestimate for the length of the Mediterranean Sea (from the Canary Islands to the eastern shores of the Mediterranean); Ptolemy overestimated it at 63 degrees of longitude, while al-Khwarizmi almost correctly

estimated it at nearly 50 degrees of longitude. Al-Ma'mun's geographers "also depicted the Atlantic and Indian Oceans as open bodies of water, not land-locked seas as Ptolemy had done. " Al-Khwarizmi thus set the Prime Meridian of the Old World at the eastern shore of the Mediterranean, 10–13 degrees to the east of Alexandria (the prime meridian previously set by Ptolemy) and 70 degrees to the west of Baghdad. Most medieval Muslim geographers continued to use al-Khwarizmi's prime meridian. Other prime meridians used were set by Abû Muhammad al-Hasan al-Hamdânî and Habash al-Hasib al-Marwazi at Ujjain, a centre of Indian astronomy, and by another anonymous writer at Basra.

3.4 KEY WORDS

Patronized. Astronomy Book of Casio sititics Cartography

3.5 QUESTIONS: FOR SELF STUDY

1. Discuss the growth of major branches of geography during the medieval times.
2. Explain the chief endowments of the Arabs to the growth of modern geography.
3. Explain the development of map making and cartography by the medieval geographers.

3.6 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.
2. Fundamentals of geographical thought: Sudeepta Adhikari, Chaitanya publishing house, Allahabad, 1995.

UNIT : 4 CONTRIBUTION OF INDIAN GEGRAPHERS FOR THE DEVELOPMENT OF GEOGRAPHY

Structure

4.0 OBJECTIVES

- To study the idea about the shape and size of the earth in ancient India.
- To study the growth of geographical knowledge about the origin of the earth in ancient India.
- To study the nature of current status of geographical knowledge in modern post independent India.

4.1 INTRODUCTION

Indian geography has a long history. In fact, various geographical concepts have been developing since the dawn of Indian civilization. Although a systematic account of the classical Indian geographical concepts is not available, yet some valuable geographical information is contained in Hindu mythology, philosophy, epics, history and sacred laws. Chronologically the Ramayana, the Mahabharata, the works of Buddhists and Jain, and the Puranas are the main sources of ancient Indian geographical concepts.

The crux of any physical phenomenon, every major or spectacular landmark on the earth's surface has a religious background for Indians. Every mountain peak, every river, and tree is sacred and is preserved in these traditions. Apart from records related to religious, travels, commercial, or related to expedition contains description of different geographical regions of the subcontinent or the world. The accounts of these travelers reveal that India had closer links with the neighboring lands and Indian scholars were familiar with the geographical conditions of china, south-east Asia, Central Asia, Mesopotamia, and the trans Oxus Asia.

An in-depth study of the religious records, historical accounts and travelogues reveals that the ancient Indian scholars had fairly accurate concepts regarding cosmology and cosmography. They also had a good knowledge of the various continents, mountain systems, rivers, fauna and flora and the sub continent and the lands lying in its vicinity.

The work done by Varahmihira, Brahmagupta, Aryabhatta, Bhaskarcharya, Bhattila, Utpala, Vijayanandi and others has substantially helped the development of astronomy, mathematical geography and cartography. Thus, geography of the ancient time appears to have included astronomy in its sphere. The term geography in Indian geographical literature was used for the first time by Suryasidhanta, and in the Puranas a difference has been made between geography, cosmology and astrology.

4.2 THE UNIVERSE AND ITS ORIGIN

The universe and its origin remained a point of speculation among all the ancient civilizations of Egypt, Babylonia, china, Greece and Rome. The ancient Indian scholars of the Vedic and ancient periods gave considerable thought to this matter. The ancient Indian literature deals with many problems pertaining to cosmology and cosmography. For example, issues like whether matter existed prior to the creation of the world or whether the universe was fashioned out of a pre existing substance or if it was made out of nothing are mentioned in the Vedas and the Puranas. The cosmology of the Vedas which has a strong bearing on the Ancient views may be summarized as (a) artistic origin of the universe, (b) mechanical origin (c) instrumental origin, and (d) philosophical origin.

The Rig Veda mentions a number of gods who performed various functions during the process of creation. These gods were artists who contributed their skill to the construction and completion of the universe. They wove various materials into a pattern, and shaped the universe by blasting and smelting. The universe was compared to a hose and Rig Veda alludes to various stages in the construction of this universal house.

The views regarding the mechanical origin of the universe developed in the last phase of Rig-Veda period. It suggests the sacrifice or disintegration of the primeval body know as *adipurusa* who is conceived as soul and the nucleus of the universe and an embodiment of the supreme spirit. The sky, the wind, the moon, the sun, and all the terrestrial elements were the result of dismemberment of man as a result of sacrifice ceremony.

The philosophical theory of cosmogony has its origin in the song of creation which says that in the beginning there was either being, or not being. There was no atmosphere, no sky, no day, and no nights. The space was empty but for a unit which was born by its own nature, perhaps due to its inherent heat. This heat has been explained by Wilson as austerities, but it may conveniently be considered as a physical action in the process of formation of the universe.

The instrumental origin of universe is based on the occurrence of parent bodies from which the universe was created. The various gods and goddesses are mentioned as having been instrumental in the creation of the earth and the heaven- the twin parents of the whole universe. The union of the earth and the heaven results in the birth of the sun which is the most important agent in the creation of the world. He is the soul of all that moved or not moved, the sun has filled the air and the earth and heaven. The universe was conceived as

very immense and wide which cannot be described. In the epics and puranas, it was however divided into seven upper and seven internal divisions.

About the origin of the earth, it has been mentioned in the Upanishads that in the beginning death concealed all; water was produced after worshipping death, from which the earth was originated. According to the Puranas, there was neither day nor night, neither light nor darkness and nothing else.

Unlike our modern scientists, the ancient Indian astronomers believed in a geocentric universe. In the Rig-Veda, we come across the description of 34 heavenly bodies including the sun, the moon, five planets and 37 constellations. The five planets have been described as the five gods. The astronomers of the ancient period established nine planets, namely, the sun, the moon, the Mars, the Mercury, the Jupiter, the Venus, and the Saturn. The astrophysical characters of some of the planets have been described in classical literature. The Mercury has been taken to be of Green color, Venus of white color, Mars of red color, Jupiter of yellow color and Saturn of black color.

4.3 ECLIPSES

The ancient Indian scholars were also conscious of the causes of eclipses. It was because of this knowledge that they advocated performing of some rituals and ceremonies on the days when eclipses occurred. The Aryans considered an eclipse inauspicious and a herald of disaster. It was also believed that if a solar and a lunar eclipse occurred in the same month, it becomes more disastrous. Varahamihira has considered the effects of eclipse month wise and emphasized the fact that eclipse in December leads to famine and its occurrence in April and May results in good rainfall, while an eclipse in March and June are inauspicious.

4.4 EARTH

The concept of earth is the most basic concept in the study of geography. The word earth has been used profusely in the Vedas and the classical literature. The word geography in the ancient Indian literature signifies the spherical shape of the earth. The spherical shape of the earth was visualized by Aitareya Brahmana who stated that sun neither sets, nor rises. We feel that it sets, but in reality, at the end of the day, it goes to the other side. Thus, it makes night on this side and day on the other. There is other evidence like the shadow of the earth during lunar eclipse which is circular. From this it may be inferred that the earth is spherical in shape.

4.4.1. Size Of The Earth

Earth is an oblate spheroid slightly flattened at the poles; its equatorial diameter measures 12,757 km, and its polar diameter 12,713 km. In the Vedic and ancient literature, no definite information regarding earth's dimensions is available, but later literature of the 5th and 6th centuries A.D in astronomy which gives somewhat convincing information.

4.4.2 Latitudes And Longitudes

The position of a point on the earth's surface in relation to equator, expressed as its angular distance from the equator, is known as latitude, while longitude is the angular distance of a given point measured in degrees east or west of the Greenwich meridian.

The classical Indian astronomers were conscious of the importance of latitudes and longitudes in the determination of a point or place on the earth's surface. In the ancient literature, there are references about latitudes and longitudes. On the basis of latitudes, they have divided the earth into various regions. For example, the hell represents the equatorial belt while the North Pole is 90° latitude. Ceylon is placed on the equator and on the North Pole is the mountain of Meru, with its antipode (nadir) on the South Pole named as Badavanala. The longitude of Ujjain passing through land and Mt. Meru were taken as the prime meridian by the Indian astronomers.

4.4.3. Cardinal Points

The Rig Veda initially formulated the principle of four directions i.e., East, West, North and South by adding the zenith and Meru it became six. Afterwards eight and ten directions are frequently mentioned in the ancient literature. The designation of directions in the ancient literature and subsequent literature Saptapadarhi is significant in the sense that it bears the original concept of the gods dominating in each of them. The ten directions are East, South-East, South, South-West, West, North-East, North, North-East, Zenith, and Nadir.

The classical Indian astronomers were also aware of the fact that local time of a place, depends upon the position of the sun or the moon in the sky, and it differs from that of other places situated along other meridians,. They devised a method of calculating these differences. Some significant phenomena in the sky, like a lunar eclipse, was observed simultaneously from different places, the exact time, showing contact of eclipse or its totality, was recorded in terms of the local time of the individual places. A comparison of these records could provide the correct difference in local times and consequently the longitudinal difference between individual places.

4.4.4 Origin

So far as the origin of the earth and the rock material of the earth crust is concerned, the ancient Indian scholars believed in solidification of earth from gaseous matter. The earth crust, according to them, was made of hard rock, clayey and sandy. The ancient literature considers the earth to be floating on water like a sailing boat in a river. The Aryans considered the problem of the distribution of land and sea and held the view that more land surface was to be found in the Northern hemisphere.

4.4.5 Earthquakes

The Word Earthquakes Have Been Used In The Ancient Indian Literature. It Was Assumed That Earthquakes Were Caused By Gods. This Shows That The Ancient Scholars Had A Fairly Good Knowledge About The Origin Of The Earth Quakes. Similarly They Have Some Knowledge About The Origin Of Volcanoes.

4.4.6 Atmosphere, Weather And Climate

The evidences in the ancient scriptures clearly reveal that the people were quite familiar with atmosphere, weather and climate. According to them, the earth was surrounded by atmosphere which exists between the earth and the heaven. The Rig Veda mentions that the thickness of the atmosphere cannot be traversed by birds. They also furnish a lot of information regarding the atmosphere. Bhaskaracharya has conceived the thickness of the atmosphere to be 154 km around the earth in which winds, clouds, lightning, rain, fog and frost occur.

The five seasons are also defined in the scriptures. They are the spring, summer, rainy, autumn, winter and severe winter.

4.5 CONTINENTS

In the early period of human civilization, owing to poor means of transportation and communication, knowledge of various parts of the world was very limited and it grew at slow pace. To explore the unknown parts of the world is an inherent habit of man. In fact the ancient Indian explorers and travelers made voyages, travels, pilgrimages and military expeditions to acquire knowledge about the unknown parts of the world. As per the scriptures the landmass of the earth was divisible into several continents. The word has been interpreted differently by different scholars.

Originally a continent signified a land bounded by water (ocean, river, lake or by a combination of these water bodies) on all sides. Thus, continents were equally applied to an

island, a peninsula or a Doab (land between two rivers). It also explains that continents to include any land which was ordinarily inaccessible or detached by virtue of its being surrounded by water, sand, swamp or even high mountains or thick forest. Thus the continent by accident or design, cam to signify a natural region – either physiographic or climatic. The ancient India divided the whole world into seven continents.

a. Jumbo Dwipa (continent): it embraces the whole of the northern hemisphere, lying to the north of sale sea. It is surrounded by the salt ocean and lies in the heart of the concentric sequence of the dwipas. Thisinsular dwipa is further divided into sub regions called realm, the Pamir region in the north and the Tibetan plateau in the south. The jumbo is relatively lower in the south than in the north, but the central is highly elevated, Meru lying in the hert of the jumo dwipa is considered to be the heaven in the Pamir. Within this jumbo there are rivers flowing in streams in various directions chiefly Sita, Brahmaputra, Yarkand, Ganga, Harmukh glacier.

b. The other major features are that various mountain ranges extend in various directions from the Pamir. Hindukush, Baba Mountain, Trisringa (tri peaked mountain), and Vaidurya mountain lies to the west of Pamir knot.

1. Kusa dwipa: this has derived its name from Kusa-grass or Poa grass. This Dwipa stretches over Iran, Iraq and the fringing lands of the hot deserts, ie., the south west corner of the land mass round Meru which is left out in the regional pattern of Jambu Dwipa. This is a land of grasses and characterized by season droughts. It contains seven major rivers and thousands of their branches that flow when god pours down rain. In other words, these tributaries are seasonal in character. The mountains of kusa dwipa are covered with herbs, trees and creepers. Its mountains and rocks are full of minerals and precious stones. And ruled by the god of fire.

2. Plaska Dwipa

   Plaska dwipa has derived its name from Plaska tree. Wilford identified this tree with fig. one would therefore, without hesitation identify this dwipa with the basin and the surrounding lands of the Mediterranean sea.

3. puskara dwipa is the land of horrors, devoid of purity, cruel and leading to the destruction of the soul. It is the land of demon, full of awful hollows which are twenty in number.

   The name of this dwipa has been derived from the fact that it is surrounded by puskara (lakes of lotuses). This dwipa is bounded by a huge circular chain of lakes. The people

living in puskara dwipa are nomads, hunters and in general primitive and savage. One side of the dwipa is a dry desert and the other side is suitable for human occupation. It promises a paradise for those who approach the dwipa from one direction, while it presents the appearance of a wasteland if one enters it from the opposite direction. Such phenomena of knife-edge boundaries between two regions of strong contrast are not uncommon. Puskara dwipa is surrounded by an ocean of fresh water and surrounds the sea of milk. Theis region sprawls over the Scandinavian lands (Norway, Sweden, finland, Denmark). These countries contain numerous lakes, support nomadic people who live by hunting and are washed by arctic waters and bering sea which have fresh water and low salinity.

4. salmal dwipa

This is deried by its name from silk cotton tree., it consists of the tropical part of aftica bordering to the west of the Indian ocean. It includes madaghascar, the arab and Persia. The main characteristic of this dwipa is silk cotton tree. This tree is commonly found on the margins of equatorial regins of monsoon lands with moderaterainfall. It is a region of high cloudiness. Consequenstly no star, planet or moon is visible. The people of this dwipa are essentially food gatherers and not food producers. The vegetatin cover produces enough food to satisfy their needs.

5. Kraunca dwipa

The Mahabharata locates this dwipain the north and west of meru. This dwipa is watered by thousands of streams in addition to the seven important rivers which carry great volume of water. The dwipa, therefore, is definitely a humid region with abundant rainfall. The entire north west Europe, including british isles. Thus constitutes the parts of this dwipa.

6. Saka dwipa

This is identified as a wide stretch of land to the south est of tha jambo dwipa, covering the presnt Burma, Thailand, Vietnam, Malaysia, Indonesia and the islads of the south east asia (east Indies). This has hot and moist climate with thick cover of evergreen forests.

Apart from the continents the classical Indian scholars also tried to delineate the boundaries and frontiers of the Indian subcontinent. In the Vedic and Ancient literature, India has been given different names but Bharat is the one most commonly used in them.

4.6 DEVELOPMENT OF GEOGRAPHY IN CURRENT TIMES

The subject of geography in India has certainly grown impressively during the past couple of decades. Indian Geographers are also being recognized worldwide. Teaching and research in Geography is channelized through a large number of geography departments spread all over the country. Geography has been shifted to the science faculty in many universities enabling good research and labs. Many of the traditional departments of geography have begun to cultivate new techniques in GIS and Remote Sensing technology. Besides there are many branches of geography which have made tremendous strides in their growth and development in India in the current times. Some of the major branches in geography are getting enormous impetus especially due to the nature of conditions existing in India, and to find solutions to the problems, several major projects are getting focused in specific areas of research.

Resource and Environment

Environmental issues now occupy a significant place in academic discourse. The Situation of India with regard to environmental crisis and resource depletion is deepening in the wake of rapid changes brought about by the new regime of economic liberalization and penetration of transnational. However, few geographers have been able to take a holistic view of environment. **Geomorphology**

Problems like stability of coastal structures, desertification, land resource appraisal etc. are emerging as major topics of research being handled or expected to be handled by the geomorphologists in India.

Climatology, Soil Geography and Bio-Geography

As these fields of geography thrive on links with disciplines like meteorology, soil science and life sciences, the range of non-geographers' contributions to the study of climate, soil and bio-resources is also growing considerably.

Agricultural Geography

Agriculture continues to be the backbone of Indian economy and rightly remains a major thrust area in geography. Agricultural geographers in India have diversified their interests and have ventured into significant areas of analysis such as land capability classification, agro-ecological concerns, crop diversification and diffusion, problems of food security and vulnerability, dairy farming apart from social and institutional framework of agriculture.

Industrial Geography

In spite of tremendous potential in this field of research, particularly in the post Liberalization phase, not much work appears to have been made. Very few papers have been published in this branch of geography in leading journals of India. This is particularly true in the context of a vibrant trend of research in this field during the eighties and nineties.

Population Geography

Population related issues remained central to geographical discourse. Issues that have caught geographers' attention include population distribution; density and growth; population composition; fertility and reproductive health; mortality and morbidity, migration and human development. Migration, both internal and international, appears to be one of the major focuses of researches. Besides; migration from across the international borders, which has led to conflicts and political

Settlement Geography

This is a traditionally important area of research that has attracted good number of researches. Moving away from the conventional analysis of size, form and location of settlements, Indian geographers have made important contribution to studies on functional aspects and location characteristics of human activities as well as spatio-functional organization of economic landscape. Issue pertaining to the impacts emanating from hyper-urbanization and diversified urban systems are recommended as important areas for future research.

Urbanization

Urban geography is one of the most dynamic sub-disciplines of geography. However, the Indian geographers have viewed urban processes as a demographic phenomenon drawing largely on data available from successive census operations.

Nevertheless, Indian urban geography has been unfolding several new dimensions including environmental issues of the built environment and sustainability of the present urban systems.

Regional Development and Planning

Economic reforms initiated in India in the nineties and its regional impacts-both apparent and likely-have dominated researches in this field of study. The studies indicate that the shackles of a centralized planning perspective has largely become unrecognizable and on the other hand, a more local based concern, grass-root based issues but not entirely discounting the

broader canvass, have come to stay in the subject as it has been evolving in India over a decade or so.

Historical Geography

Historical geography has never been a priority area in Indian geography, though its importance can hardly be overemphasized. Most of the studies cited in the review do not come from geographers, nor can they strictly be considered as historical-geographical researches.

Social Geography

Social issues have received adequate attention by a number of geographers. The immediate cause for a shift in interest in socio-geographical research appears in the post-modern discourse that has caught the attention of Indian geographers following their western counterparts. A few geographers have however continued with studies of caste and morphology of rural settlements, spatial aspects of language and shifts in language and ethnic conflicts and the like.

Cultural Geography

The post-modern research has certainly given a new meaning to studies in cultural geography. But, this branch has mostly been used as a way and approach narrating or analyzing landscape and culture, putting aside the theoretical construction and critique of the philosophical ideas as popular in the West. More western scholars than Indian have evinced interest in cultural forms, mostly of its mythical dimension. The geographical implication of cultural pluralism has hardly received any attention. While ancient Indian traditions have been overemphasized, few talk about contemporary cultural development including globalization of culture and its impact.

Geography of Health

As a branch, Geography of Health has made significant strides. It has progressed from studies in ecological associations of diseases and attempts at disease mapping, to investigations into a wider perspective of health and health care with a focus on human welfare. Cultural and the structural approaches to address the problems of health and place are dimensions that distinguishes this field of enquire from its past. However, many, if not all studies stop at a cartographic representation of diseases showing inter-state or inter-district variation in the prevalence pattern and hardly move beyond the level of description.

Social Wellbeing and Transformation

Studies pertaining to health dominate in this field while issues concerning housing remain neglected. Most studies continue to rely on cartographic representation of facts without placing the issues in a proper theoretical context. Recent impacts of globalization, liberalization and economic restructuring which are bound to have immense effects on the process of social transformation and social well-being find rare mention by Indian geographers.

Political Geography

Political geography in India has been a neglected field of inquiry in the past, and continues to be marginalized even at present. This is in spite of tremendous potential of the sub discipline in contributing to varied political problems directly linked to geographical backgrounds and territorial identification as well as external space-relations. Unfortunately barring a few notable exceptions, much of the interest is centered on electoral geography. The field needs to concentrate on issues of urgent national importance such as political implications of social and cultural pluralism and related issues of conflict as well as integration, problems of nation building, federalism and above all the political geography of underdevelopment.

Administrative Geography

There has been world over, a significant increase in the expression of concern for the neglect of policy-relevant research in human geography. Only a few geographers in India have evinced interest in this vitally important area in which geographers should contribute significantly with their skills of understanding the 'natural' and 'human' in synthesis rather than in isolation.

Remote Sensing and Geographical Information System

During the last decade geographers have shown an increased interest in the application of remote sensing techniques and GIS not only as part of the curriculum but also in the researchers conducted in all the branches of geography. Such techniques are crucially dependent on computer as a tool. And the Indian population generally does have an excellent aptitude in computers, and Indian geographers have fared very well in remote sensing and GIS, besides the governmental support and the Indian remote sensing mission has facilitated in providing satellite data at reason prices with very good temporal frequency and high spatial resolution.

4.7 LET US SUM UP

India has been very actively participating in the developmental activities and knowledge generation of geography even from the ancient times. The chief areas of contribution is in the field of astronomy, geometry, mathematics and map making. Besides regional geography also was also a cherished branch of geography in the ancient times chiefly due to the basic curiosity of the surrounding and world at large. In the current times also the subject is taking fast strides in making the subject a part of the administration and decision making process. Especially with the introduction of remote sensing and GIS geography has witnessed many laurels and the future is still to be scaled.

4.8 KEY WORDS

Cardinal points, Jumbo Dwipa, Kusa Dwipa, Puskara Dwipa, Salmal Dwipa, Kraunce dwipa, Saka Dwipa

4.9 QUESTIONS FOR SELF STUDY

1. Explain the concept of continents in ancient India.
2. Discuss the contribution of ancient Indian geographers in the field of various geographical phenomena.
3. Explain the recent contributions of Indian geographers for the development of the subject of geography.

4.10 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.
2. **A Country Report *Progress In Indian Geography.* 2004-2008,** 31st International Geographical CongressTunis, Tunisia, August 12-15, Edited by R.B.Singh.

UNIT : 5 IMPACT OF GEOGRAPHICAL DISCOVERIES

Structure

5.0 OBJECTIVES

After Studying this unit you will be able to

- Know the exploration Age in between 15th cartmy and casted unit the 17th Century
- Understand the adventurous discoveries of the different continents and connives and the how the earth was completely explored

5.1 INTRODUCTION

Though the desire to simply explore the unknown and discover new knowledge is a typical human trait, the world's famous explorers often lacked the funding needed for a ship, supplies, and a crew to get underway on their journeys. As a result, many turned to their respective governments which had their own desires for the exploration of new areas.

Many nations were looking for goods such as silver and gold but one of the biggest reasons for exploration was the desire to find a new route for the spice and silk trades. When the Ottoman Empire took control of Constantinople in 1453, it blocked European access to the area, severely limiting trade. In addition, it also blocked access to North Africa and the Red Sea - two very important trade routes to the Far East.

The first of the journeys associated with the Age of Discovery were conducted by the Portuguese under Prince Henry the Navigator. These voyages were different than those previously conducted by the Portuguese because they covered a much larger area. Earlier sailors relied on portolan charts which are maps created for navigators based on land features. Because these charts relied on the ability to see land, the voyages prior to those conducted by Prince Henry stayed along the coastlines.

In challenging this form of navigation, the Portuguese sailed out of sight of land and discovered the Madeira Islands in 1419 and the Azores in 1427. The main goal for the Portuguese voyages though was to discover a trade route to West Africa without having to go through the Sahara Desert. By the mid-1400s, this goal was realized and a trading port was established at Elmina in West Africa.

Also during the Age of Discovery were the famed voyages of Christopher Columbus. These voyages started as an attempt to find a trade route to Asia by sailing west. Instead, he reach America in 1492 and shared information on this newly found land with Spain and the rest of Europe. Shortly thereafter, the Portuguese explorer Pedro Alvares Cabral explored Brazil, setting off a conflict between Spain and Portugal in terms of the newly claimed lands. As a result, the Treaty of Tordesillas officially divided the world in half in 1494.

Some other important voyages of exploration that took place during the Age of Exploration were Ferdinand Magellan's attempted circumnavigation of the globe, the search for a trade route to Asia through the Northwest Passage, and Captain James Cook's voyages that allowed him to map various areas and travel as far as Alaska.

5.2 CONTRIBUTIONS OF EXPLORATION TO GEOGRAPHY

Even though much of the travel during the Age of Exploration was done in an effort to find new trade routes, it did have a significant impact on geography. By traveling to different regions around the globe, explorers were able to learn more about areas like Africa and the Americas. In learning more about such places, explorers were able to bring knowledge of a larger world back to Europe.

In addition to just learning about the presence of the lands themselves, these explorations often brought various new species (important to biogeography) and new cultures of people to light. For example, Cook's voyages brought back a significant amount of information from previously unvisited parts of the world.

Methods of navigation and mapping also improved as a result of the travels of people like Prince Henry the Navigator. Prior to his expeditions, navigators used traditional portolan charts which kept them tied to the shoreline. Among the many goals of his expeditions were to develop a new nautical chart so future sailors could sail out of sight of land. He did so, creating one of the first nautical maps. These would later be further refined by explorers like Vasco De Gama, Columbus, and Cabral.

The Age of Exploration served as a stepping stone for geographic knowledge. It allowed more people to see and study various areas around the world which increased geographic study, giving us the basis for much of the knowledge we have today.

5.3 GREAT EXPLORERS OF THE WORLD

5.3.1. MARCO POLO (Discovery of the far east) :

Marco born in 1254 and started his expeditions at the age of fifteen. In 1271 he with his two uncles began to trek eastward and in 1275 arrived at the capital of Mongol. The king liked the youthful Marco and appointed him into service for the Empire. Marco served in several high-level government positions, including as ambassador and as the governor of the city of Yangzhou. The king enjoyed having the Polos as his subjects and diplomats, he eventually consented to allow them to leave the Empire, as long as they would escort a princess who was scheduled to wed a Persian king.

The three Polos left the Empire in 1292 with the princess, a fleet of fourteen large boats, and 600 other passengers from a port in southern China. The armada sailed through Indonesia to Sri Lanka and India and onto its final destination at the Strait of Hormuz in the Persian Gulf. Supposedly, only eighteen people survived from the original 600. The three Polos returned to Venice and Marco joined the army to fight against the city-state of Genoa. He was captured in 1298 and imprisoned in Genoa. While in prison for two years, he dictated an account of his travels to a fellow prisoner named Rustichello. Shortly thereafter, The *Travels of Marco Polo* was published in French.

Though Polo's book exaggerates places and cultures (and some scholars believe he never went as far east as China but only described places other travelers had been to), his book was widely published, translated into many languages, and thousands of copies were printed.

Polo's book includes fanciful accounts of men with tails and cannibals seem to be around every corner. The book is somewhat a geography of Asian provinces. It is divided into chapters covering specific regions and Polo delves into the politics, agriculture, military power, economy, burial system, and religions of each area. Polo brought the ideas of paper currency and coal to Europe. He also included second-hand reports of areas that he had not visited, such as Japan and Madagascar.

The influence of Marco Polo on geographic exploration was enormous and he was also a major influence on Christopher Columbus. Columbus owned a copy of Travels and made annotations in the margins.

As Polo neared death in 1324, he was asked to recant what he had written and simply said that he had not even told half of what he had witnessed. Despite the fact that many claim his book to be unreliable, it was a sort of regional geography of Asia for centuries. Even today, "his book must stand among the great records of geographic exploration."

5.3.2. CHRISTOPHER COLUMBUS (Discovery of Americas) :

Was born in Genoa (located in Italy today) in 1451 he was well-educated because he was able to speak several languages as an adult and had considerable knowledge of classical literature. In addition, he studied the works of Ptolemy and Marinus to name a few.

Columbus first took to the sea when he was 14 years old and this continued throughout his younger life. During the 1470s, he went on numerous trading trips that took him to the Aegean Sea, Northern Europe, and possibly Iceland. In 1479, he met his brother Bartolomeo, a

mapmaker, in Lisbon. He later married Filipa Moniz Perestrello and in 1480, his son Diego was born.

The family stayed in Lisbon until 1485, when Columbus' wife Filipa died. From there, Columbus and Diego moved to Spain where he began trying to obtain a grant to explore western trade routes. He believed that because the earth was sphere, a ship could reach the Far East and set up trading routes in Asia by sailing west.

For years, Columbus proposed his plans to the Portuguese and Spanish kings, but he was turned down each time. Finally, after the Moors were expelled from Spain in 1492, King Ferdinand and Queen Isabella reconsidered his requests. Columbus promised to bring back gold, spices, and silk from Asia, spread Christianity, and explore China. He then asked to be admiral of the seas and governor of discovered lands.

Columbus' First Voyage

After receiving significant funding from the Spanish monarchs, Columbus set sail on August 3, 1492 with three ships, and 104 men. After a short stop at the Canary Islands to resupply and make minor repairs, the ships set out across the Atlantic. This voyage took five weeks - much longer than Columbus expected, as he thought the world was smaller than it is. During this time, many of the crew members contracted diseases and died, or died from hunger and thirst.

Finally, on October 12, 1492, they sighted land in area of the present-day Bahamas. When Columbus reached the land, he believed it was an Asian island and named it San Salvador. Because he did not find riches, Columbus decided to continue sailing in search of China. Instead, he ended up visiting Cuba and Hispaniola.

On November 21, 1492 Columbus had to leave, keeping about 40 men behind at a fort they named Navidad. Soon after, Columbus set sail for Spain, where he arrived on March 15, 1493, completing his first voyage west.

Columbus' Second Voyage

After the success of finding this new land, Columbus set sail west again on September 23, 1493 with 17 ships and 1,200 men. The purpose of this journey was to establish colonies in the name of Spain, check on the crew at Navidad, and continue his search for riches in what he still thought was the Far East.

On November 3, the crew members sighted land and found three more islands, Dominica, Guadeloupe, and Jamaica, which Columbus thought were islands off of Japan. Because there were still no riches there, they went on to Hispaniola, only to discover that the fort of Navidad had been destroyed and his crew killed after they mistreated the indigenous population.

At the site of the fort Columbus established the colony of Santo Domingo and after a battle in 1495, he conquered the entire island of Hispaniola. He then set sail for Spain in March 1496, and arrived in Cadiz on July 31.

Columbus' Third Voyage

Columbus's third voyage began on May 30, 1498 and took a more southern route than the previous two. Still looking for China, he found Trinidad and Tobago, Grenada, and Margarita, on July 31. He also reached the mainland of South America. On August 31, he returned to Hispaniola and found the colony of Santo Domingo there in shambles. After a government representative was sent to investigate the problems in 1500, Columbus was arrested and sent back to Spain. He arrived in October and was able to successfully defend himself against the charges of treating both the locals and Spaniards poorly.

Columbus' Fourth and Final Voyage and Death

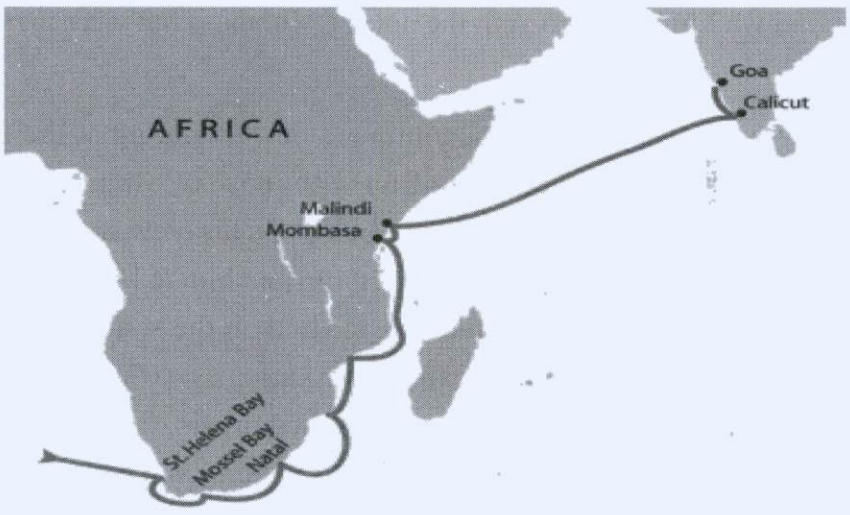
Columbus' final voyage began on May 9, 1502 and he arrived in Hispaniola in June. Once there, he was forbidden from entering the colony so he continued to explore further. On July 4, he set sail again and later found Central America. In January 1503, he reached Panama and found a small amount of gold but was forced out of the area by those who lived there. After numerous problems and a year of waiting on Jamaica after his ships had problems, Columbus set sail for Spain on November 7, 1504. When he arrived there, he settled with his son in Seville.

After Queen Isabella died on November 26, 1504, Columbus tried to regain his governorship of Hispaniola. In 1505, the king allowed him to petition but did nothing. One year later, Columbus became ill and died on May 20, 1506.

5.3.3. VASCO DA GAMA(Discovery of sea route to India), :

1460-1524 was a Portuguese explorer, one of the most successful in the European Age of Discovery and the commander of the first ships to sail directly from Europe to India. Little is known of Vasco da Gama's early life. He may have learned mathematics and navigation. It is evident that Gama knew astronomy well. In 1492 King John II of Portugal sent Gama to

the port south of Lisbon and to the Algarve to seize Frenchships in retaliation for peacetime depredations against Portuguese shipping - a task that Vasco rapidly and effectively performed.



The route followed in Vasco da Gama's first voyage (1497 - 1499).

On 8 July 1497 the fleet, consisting of four ships and a crew of 170 men, left Lisbon. The expedition set sail from Lisbon on July 8, 1497, following the route pioneered by earlier explorers along the coast of Africa via Tenerife and the Cape Verde Islands. After reaching the coast of present day Sierra Leone, Gama took a course south into the open ocean, crossing theEquator and seeking the South Atlantic westerlies that Bartolomeu Dias had discovered in 1487. This course proved successful and on November 4, 1497, the expedition made landfall on the African coast. For over three months the ships had sailed more than 6,000 miles of open ocean, by far the longest journey out of sight of land made by the time.

Rounding the Cape By December 16, the fleet had passed the Great Fish River and sailed into waters previously unknown to Europeans. With Christmas pending, Gama and his crew gave the coast they were passing the name Natal, which carried the connotation of "birth of Christ" in Portuguese. Arab-controlled territory on the East African coast was an integral part of the network of trade in the Indian Ocean. Gama impersonated a Muslim and gained audience with the Sultan of Mozambique. With the paltry trade goods he had to offer, Gama was unable to provide a suitable gift to the ruler and soon the local populace became suspicious of Gama and his men. Forced by a hostile crowd to flee Mozambique, Gama departed the harbour, firing his cannons into the city in retaliation.

Mombasa

In the vicinity of modern Kenya, the expedition resorted to piracy, looting Arab merchant ships - generally unarmed trading vessels without heavy cannons. The Portuguese became the first known Europeans to visit the port of Mombasa but were met with hostility and soon departed.

In February 1498, Vasco da Gama continued north, landing at the friendlier port of Malindi - whose leaders were then in conflict with those of Mombasa - and there the expedition first noted evidence of Indian traders. Gama and his crew contracted the services of a pilot whose knowledge of the monsoon winds allowed him to bring the expedition the rest of the way to Calicut (modern Kozhikode), located on the southwest coast of India. Sources differ over the identity of the pilot, calling him variously a Christian, a Muslim, and a Gujarati. One traditional story describes the pilot as the famous Arab navigator Ibn Majid, but other contemporaneous accounts place Majid elsewhere, and he could not have been near the vicinity at the time.

Calicut, India

The fleet arrived in Calicut on 20 May 1498. Negotiations with the local ruler, the Zamorin of Calicut, occasionally took on a violent nature. Efforts by Gama and the Portuguese to obtain favorable trade terms were complicated by resistance from indigenous Arab merchants. Eventually Gama was able to gain an ambiguous letter of concession for trading rights, but he had to depart without giving notice of his intention to do so after the Zamorin insisted that Gama leave all his goods as collateral. Vasco da Gama kept his goods, but left a few Portuguese with orders to start a trading post.

Return

Vasco da Gama set sail for home on August 29, 1498. Eager to leave he ignored the local knowledge of monsoon wind patterns, which was still blowing onshore. Crossing the Indian Ocean to India, sailing with the monsoon wind, had taken Gama's ships only 23 days. The return trip across the ocean, sailing against the wind, took 132 days, and Gama arrived in Malindi on January 7, 1499. During this trip, approximately half of the crew died, and many of the rest were afflicted with scurvy. Two of Gama's ships made it back to Portugal, arriving in July and August of 1499.

Paulo da Gama died in the Azores on the homeward voyage. Vasco da Gama returned to Portugal in September 1499 and was richly rewarded as the man who had brought to fruition a plan that had taken eighty years to fulfill. He was given the title "Admiral of the Indian Seas," and his feudal rights to Sines were confirmed. Manuel I also awarded the perpetual title of *Dom*(lord) to Gama, as well as to his brothers and sisters and to all of their descendants. He was created first Earl of Vidigueira, and Gama was named the first Portuguese count who was not born with royal blood.

5.3.4. FERDINAND MAGELLAN :

(Discovery of South America)was born in 1480 in Sabrosa, Portugal. Because his family had ties to the royal family, Magellan became a page to the Portuguese queen after his parents' untimely deaths in 1490. This allowed him the opportunity to become educated and learn about the various Portuguese exploration expeditions- possibly even those conducted by Christopher Columbus.

Magellan took part in his first sea voyage in 1505 when Portugal sent him to India to help install Francisco de Almeida as the Portuguese viceroy. He also experienced his first battle there in 1509 when one of the local kings rejected the practice of paying tribute to the new viceroy.

From here however, Magellan lost the viceroy Almeida's support after he took leave without permission and was accused of illegally trading with the Moors. After some of the accusations were proven to be true, Magellan lost all offers of employment from the Portuguese after 1514.

The Spanish and the Spice Islands

Around this same time, the Spanish were engaged in trying to find a new route to the Spice Islands (the East Indies, in present-day Indonesia) after the Treaty of Tordesillas divided the world in half in 1494. The dividing line for this treaty went through the Atlantic Ocean and Spain got the lands west of the line, including the Americas. Brazil however, went to Portugal as did everything east of the line, including India and the eastern half of Africa.

Similar to his predecessor Columbus, Magellan believed that the Spice Islands could be reached by sailing west through the New World. He proposed this idea to Manuel I, the Portuguese king, but was rejected. Looking for support Magellan moved on to share his plan with the Spanish king.

On March 22, 1518, Charles I was persuaded by Magellan and granted him a large sum of money to find a route to the Spice Islands by sailing west, thereby giving Spain control of the area, since it would in effect be "west" of the dividing line through the Atlantic. Using these generous funds, Magellan set sail going west toward the Spice Islands in September 1519 with five ships (the Conception, the San Antonio, the Santiago, the Trinidad, and the Victoria) and 270 men.

The Early Portion of the Voyage

Since Magellan was a Portuguese explorer in charge of a Spanish fleet, the early part of the voyage to the west was riddled with problems. Several of the Spanish captains on the ships in the expedition plotted to kill him but their plans were never realized and many of them were held prisoner and/or executed. In addition, Magellan had to avoid Portuguese territory since he was sailing for Spain.

After months of sailing across the Atlantic Ocean, the fleet anchored at what is today Rio de Janeiro to restock its supplies on December 13, 1519. From there, they moved down the coast of South America looking for a way into the Pacific. As they sailed farther south however, the weather got worse so the crew anchored in Patagonia (southern South America) to wait out the winter.

As the weather began to ease in the spring, Magellan sent the Santiago on a mission to look for a way through to the Pacific Ocean.

Later Voyage and Magellan's Death

From here, Magellan mistakenly thought it would only take a few days to reach the Spice Islands, when it instead took four months, during which time his crew suffered immensely. They began to starve as their food supplies were depleted, their water turned putrid, and many of the men developed scurvy. The crew was able to stop at a nearby island in January 1521 to eat fish and seabirds but their supplies were not adequately restocked until March when they stopped in Guam.

On March 28, they landed in the Philippines on the Cebu Island. After spending time with the king. On April 21, 1521, Magellan took part in the Battle of Mactan and was killed.

Only one ship could make it back to Spain, on September 6, 1522 only 18 surviving crew members returned to Spain, completing the first circumnavigation of the earth.

Though Magellan died before the voyage was completed, he is often credited with the first circumnavigation of the earth as he initially led the voyage. He also discovered what is now called the Strait of Magellan, named the Pacific Ocean, and South America's Tierra del Fuego. Magellanic Clouds in space were also named for him, as his crew was the first to view them while sailing in the Southern Hemisphere. Most important to geography though, was Magellan's realization of the full extent of the earth- something that significantly aided in the development of later geographic exploration and the resulting knowledge of the world today.

5.3.5 AMERIGO VESPUCCI :

Will long be remembered as the man America was named after but who was this inconsequential explorer and how did he get his name on two continents?

Vespucci was born in 1454 to a prominent family in Florence, Italy. As a young man he read widely and collected books and maps. He began working for local bankers and was sent to Spain in 1492 to look after his employer's business interests.

While in Spain, Amerigo Vespucci began working on ships and ultimately went on his first expedition as a navigator in 1499. This expedition reached the mouth of the Amazon River and explored the coast of South America. Vespucci was able to calculate how far west he had traveled by observing the conjunction of Mars and the Moon.

On his second voyage in 1501, Amerigo Vespucci sailed under the Portuguese flag. After leaving Lisbon, it took Vespucci 64 days to cross the Atlantic Ocean due to light winds. His ships followed the South American coast to within 400 miles of the southern tip, Tierra del Fuego.

While on this voyage, Vespucci wrote two letters to a friend in Europe. He described his travels and was the first to identify the New World of North and South America as separate from Asia. (Until he died, Columbus thought he had reached Asia.)

Amerigo Vespucci also described the culture of the indigenous people, and focused on their diet, religion, and what made these letters very popular - their sexual, marriage, and childbirth practices. The letters were published in many languages and were distributed across Europe (they were a much better seller than Columbus' own diaries).

Amerigo Vespucci was named Pilot Major of Spain in 1508. Vespucci was proud of this accomplishments, "I was more skillful than all the shipmates of the whole world." Vespucci's third voyage to the New World was his last for he contracted malaria and died in Spain in 1512 at the age of 58.

5.3.6 MARTIN WALDSEEMULLER

The German clergyman-scholar Martin Waldseemuller liked to make up names. He even created his own last name by combining words for "wood," "lake," and "mill." Waldseemuller was working on a contemporary world map, based on the Greek geography of Ptolemy, and he had read of Vespucci's travels and knew that the New World was indeed two continents.

In honor of Vespucci's discovery of the new world, Waldseemuller printed a wood block map (called "Carta Mariana") with the name "America" spread across the southern continent of the New World. Waldseemuller printed and sold a thousand copies of the map across Europe.

Within a few years, Waldseemuller changed his mind about the name for the New World but it was too late. The name America had stuck. The power of the printed word was too powerful to take back. Gerardus Mercator's world map of 1538 was the first to include North America and South America. Thus, continents named for a Italian navigator would live on forever.

5.3.7 JAMES COOK :

(Discovery of Austrialia and Antarctica)was born in 1728 in Marton, England. His father was a Scottish migrant farm worker who allowed James to apprentice on coal carrying boats at the age of eighteen. While working in the North Sea, Cook spent his free time learning math and navigation. This led to his appointment as mate.

Searching for something more adventurous, in 1755 he volunteered for the British Royal Navy and took part in the Seven Years War and was an instrumental part of the surveying of the St. Lawrence River, which helped in the capture of Quebec from the French.

The First Voyage

Following the war, Cook's skill at navigation and interest in astronomy made him the perfect candidate to lead an expedition planned by the Royal Society and Royal Navy to Tahiti to observe the infrequent passage of Venus across the face of the sun. Precise measurements of this event were needed worldwide in order to determine the accurate distance between the earth and sun.

Cook set sail from England in August, 1768 on the Endeavor. His first stop was Rio de Janeiro, then the Endeavor proceeded west to Tahiti where camp was established and the transit of Venus was measured. After the stop in Tahiti, Cook had orders to explore and claim

possessions for Britain. He charted New Zealand and the east coast of Australia (known as New Holland at the time).

From there he proceeded to the East Indies (Indonesia) and across the Indian Ocean to the Cape of Good Hope at the southern tip of Africa. It was an easy voyage between Africa and home; arriving in July, 1771.

The Second Voyage

The Royal Navy promoted James Cook to Captain following his return and had a new mission for him, to find Terra Australis Incognita, the unknown southern land. In the 18th century, it was believed that there was much more land south of the equator than had already been discovered. Cook's first voyage did not disprove claims of a huge landmass near the South Pole between New Zealand and South America.

Two ships, the Resolution and the Adventure left in July, 1772 and headed to Cape Town just in time for the southern summer. Captain Cook proceeded south from Africa and turned around after encountering large amounts of floating pack ice (he came within 75 miles of Antarctica). He then sailed to New Zealand for the winter and in summer proceeded south again past the Antarctic Circle (66.5Â° South). By circumnavigating the southern waters around Antarctica, he indisputably determined that there was no habitable southern continent. During this voyage he also discovered several island chains in the Pacific Ocean.

After Cook arrived back in Britain in July, 1775, he was elected a Fellow of the Royal Society and received their highest honor for his geographic exploration. Soon Cook's skills would again be put to use.

The Third Voyage

The Navy wanted Cook to determine if there was a Northwest Passage, a mythical waterway which would allow sailing between Europe and Asia across the top of North America. Cook set out in July of 1776 and rounded the southern tip of Africa and headed east across the Indian Ocean. He passed between the North and South islands of New Zealand (through Cook Strait) and towards the coast of North America. He sailed along the coast of what would become Oregon, British Columbia and Alaska and proceeded through the Bering Straight. His navigation of the Bering Sea was halted by the impassible Arctic ice.

Upon yet again discovering that something did not exist, he continued his voyage. His last stop was in February, 1779 at the Sandwich Islands (Hawaii) where he was killed in a fight with islanders over the theft of a boat.

Cook's explorations dramatically increased European knowledge of the world. As a ship captain and skilled cartographer, he filled in many gaps on world maps. His contributions to eighteenth century science helped propel further exploration and discovery for many generations.

5.4 LET US SUM UP

The Age of Exploration ended in the early 17th century after technological advancements and increased knowledge of the world allowed Europeans to travel easily across the globe by sea. In addition, the creation of settlements along the coasts of the newly found areas created a network of communication and trade, therefore ending the need to search for trade routes.

Though the Age of Exploration officially ended in the 17th century, it is important to note however that the exploration did not cease entirely at this time. Eastern Australia was not discovered until 1770 and the Arctic and Antarctic areas were not heavily explored until the 19th century. Much of Africa also was also unexplored until the 19th and even early 20th centuries.

5.5 KEY WORDS

Ottoman, Constantinople, portolan charts, Zamorin, Malindi, Patagonia

5.6 QUESTIONS FOR SELF STUDY

1. Give an account of the events leading to the discovery of north and south America
2. Give an account of the discovery of continents of Australia and Antarctica.
3. Describe the causes for the discovery of new lands masses.
4. Critically evaluate the growth of geographical development during the age of exploration.

5.7 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.
2. Fundamentals of geographical thought: Sudeepta Adhikari, Chaitanya publishing house, Allahabad, 1995.

UNIT : 6 CONTRIBUTION OF IMMANUEL KANT AND BERNHARDUS VARENIUS

Structure

6.0 OBJECTIVES

After Studying this unit you will be able to :

- To study the revolutionary shift in the content of geography from the classical period to the modern period
- To study the change in the approach of geography from the classical period to the modern period.

6.1 INTRODUCTION

The discovery of new continents and the growth of knowledge about the earth in different regions influenced greatly to the development of a scientific approach in geography.

The growth of scientific development may be rightly attributed to the scholarly interpretation of the knowledge of the earth in the works of Immanuel Kant and Bernhardus Varenius. A somewhat different stimulus to the development of scientific geography with greater stress on empirical knowledge of the earth for philosophical consideration was made a necessary approach to geography.

6.2 SOME IMPORTANT GEOGRAPHERS

6.2.1 IMMANUEL KANT (1724 –1804)

He was a German philosopher from Königsberg, researching, lecturing and writing on philosophy and anthropology at the end of the 18th century. In his entire life, he never traveled more than ten miles from Konigsberg. Kant received a stern education. It is often held that Kant lived a very strict and predictable life. He was a popular teacher and a modestly successful author even before starting on his major philosophical works. Kant showed a great aptitude to study at an early age, at the age of 16. He studied the new mathematical physics of Newton and philosophy.

- **ASTRONOMY**

  At that time, there were major successes and advances in the sciences (for example, Isaac Newton, Carl Friedrich Gauss, and Robert Boyle) using reason and logic.

Kant is best known for his transcendental idealist philosophy that, time and space are not materially real but merely the ideal apriori condition of our internal intuition. He made an important astronomical discovery, namely a discovery about the nature of the Earth's rotation, Even more importantly, from this Kant concluded that time is not a thing in itself, determined from experience, objects, motion, and change, but rather an unavoidable framework of the human mind that preconditions possible experience.

"Kant pointed out in the middle of last century, what had not previously been discovered by mathematicians or physical astronomers, that the frictional resistance against tidal currents on the earth's surface must cause a diminution of the earth's rotational speed". This immense discovery in Natural Philosophy seems to have attracted little attention. In 1775, he wrote his General Natural History and Theory of the Celestial Bodies; or, an Attempt to Account for the Constitutional and Mechanical Origin of the Universe, upon Newtonian Principles." -

In the *General History of Nature and Theory of the Heavens* (1755), Kant laid out the Nebular hypothesis, in which he deduced that the Solar System formed from a large cloud of gas, was the great nebula. He thus attempted to explain the order of the solar system, seen previously by Newton. Kant also correctly deduced that the Milky Way was a large disk of stars, which he theorized also formed from a (much larger) spinning cloud of gas. He further suggested the possibility that other nebulae might also be similarly large and distant disks of stars. These postulations opened new horizons for astronomy: for the first time extending astronomy beyond the solar system to galactic and extragalactic realms.

- **Conceptual Reasoning Of Time And Space**

At the age of 46, Kant was an established scholar and an increasingly influential philosopher.

*Critique of Pure Reason*1781 is now uniformly recognized as one of the greatest works in the history of philosophy, Kant's reputation gradually rose through the 1780s, sparked by a series of important works:1786,*Metaphysical Foundations of Natural Science.* His work has also been a starting point for many 20th century philosophers.

According to Kant, the different process of reasoning and stages of it growth are organized in a systematic phases, such as:

1. Conceptual integration is carried out by the mind through "categories of the understanding" operating on the perception of "space and time". Any a priori experience is guided with a pre condition perceived with space and time. Thus the order of nature and the causal relation that operates between them are dependent upon the mind's processes, which Kant called "synthesis". Kant defines his theory of perception in his influential 1781 work *The Critique of Pure Reason*, Kant maintains that our understanding of the external world has its foundations not merely in experience, but in both experience and apriori concepts, which is what he and others referred to as his "Copernican revolution".

2. Kant, claims that elementary mathematics, like arithmetic, is synthetic *apriori*, in that its statements provide new knowledge, but knowledge that is not derived from experience. This becomes part of his over-all argument for transcendental idealism. That is, he argues that the possibility of experience depends on certain necessary conditions—which he calls *a priori* forms—and that these conditions structure and hold true of the world of experience. In so doing, his main claims in the "Transcendental Aesthetic" are that mathematic judgments are synthetic *a priori* and in addition, that Space and Time are not derived from experience but rather are its preconditions.

3. Deduction from the apriori experience is what Kant deemed it obvious objective knowledge of the world, such as, say, Newtonian physics. But this knowledge relies on synthetic, *a priori* laws of nature, like causality and substance. The problem, then, is how this is possible. Kant's solution was to reason that the subject must supply laws that make experience of objects possible, and that these laws are the synthetic, *a priori* laws of nature which we can know all objects are subject to prior to experiencing them. So to deduce all these laws, Kant examined experience in general, dissecting in it what is supplied by the mind from what is supplied by the given intuitions. This which has just been explicated is commonly called a transcendental reduction.

4. Testing of the hypothesis: Kant's distinction between the *a posteriori* being necessary condition and particular knowledge, and the *a priori* being universal and necessary knowledge, must be kept in mind. For if we merely connect two intuitions together in a perceiving subject, the knowledge will always be subjective because it is derived *a posteriori,* when what is desired is for the knowledge to be objective, that is, for the two intuitions to refer to the object and hold good of it necessarily universally for anyone at anytime, not just the perceiving subject in its current condition. For example,

say a subject says, "The sun shines on the stone; the stone grows warm", which is all he perceives in perception. His judgment is contingent and holds no necessity. But if he says, "The sunshine causes the stone to warm", he subsumes the perception under the category of causality, which is not found in the perception, and necessarily synthesizes the concept sunshine with the concept heat, producing a necessarily universally true judgment.http://en.wikipedia.org/wiki/Immanuel_Kant - cite_note-Prolegomena-31

- **Paradigm Shift** very little philosophy is now carried out as an extension, or in the style of pre-Kantian philosophy. This shift consists in several closely related innovations that have become axiomatic, in philosophy itself and in the social sciences and humanities generally:
- Kant's "Copernican revolution", that placed the role of the human subject or knower at the center of inquiry into our knowledge, such that it is impossible to philosophize about things as they are independently of us or of how they are for us.
- his invention of critical philosophy, that is of the notion of being able to discover and systematically explore possible inherent limits to our ability to know through philosophical reasoning.
- his creation of the concept of "conditions of possibility", as in his notion of "the conditions of possible experience" – that is that things, knowledge, and forms of consciousness rest on prior conditions that make them possible, so that to understand or know them we have to first understand these conditions.
- His theory that objective experience is actively constituted or constructed by the functioning of the human mind.
- Kant believed that mathematical truths were forms of synthetic a priori knowledge, which means they are necessary and universal.
- **Content Of Geography**

A major portion of Kant's teaching activity was devoted to trying to enlighten his students more about the people and world around them in order that they might live pragmatically as well as morally better lives. His teachings contain a history of the contemporary condition of the earth or geography, in the widest sense. Knowledge of the world for Kant is thus both 'the human being and nature.' Physical geography studies nature, anthropology the human beings, but the latter outweighs the former, since 'nature exists for

the sake of the human being and the human being is the end of nature.' Anthropology and geography are thus crucial to Kant's entire enterprise, throughout his career and across the so called pre critical and critical periods.

Kant was an innovator in geography; Kant attempted to systematize the subject from physical and human dimension. The physical geography includes elements such as descriptions of the earth and its terrain, earthquakes, climate, the atmosphere, and temperature, and rivers and water. There are also extensive discussions of flora, fauna and minerals. The final part comprised a series of descriptions of particular regions and places in the world. The geography of Kant's period was largely practical and that Kant's role was important in terms of the codification and ordering of knowledge. Marcuzzi discusses the relation between history and geography in Kant's lectures, focusing especially on the introduction to the physical geography. In doing so, Marcuzzi opens up a number of key themes in the text that relate to Kant's wider concerns, including the understandings of space and time; the relation between science and philosophy; race and breeding; and the relation between geography and anthropology. It thus acts as an effective bridge towards a cosmopolitan education:

Geography and anthropology: Kant saw a particular relation between geography and anthropology. And indeed the anthropology lectures were initially part of the geography courses. Even when he split them apart, Kant continued to see them as closely related. He believed that physical geography and pragmatic anthropology together provided knowledge of the world, which is an empirical grounding for his thought. This knowledge of the world, for Kant, was integral to the moral and political life of the citizen. He believed that physical geography is about the world as an object of external sense and anthropology as an object of inner sense. Knowledge of the world is thus of both 'the human being and nature, and anthropology and geography are thus 'intersecting halves of a larger whole'. In his book on geography 1765-66 he writes that the discipline will include the other parts of the subject which are of even greater utility. This discipline will therefore be a physical, moral and political geography. It will contain, first of all, a specification of the remarkable features of nature in three realms. The specification will, however be limited to those features, among the innumerable many which could be chosen, which particularly satisfy the general desire of knowledge, either because of their rarity or the effect which they can exercise on states by means of trade and industry. This part of the subject, which also contains a treatment of the natural relationship which holds between all the lands and seas in the world, and the reason for their connection, is the essential foundation of all history. Without this foundation history is scarcely distinguishable for a fairy tales.

The second part of the subject considers human beings, throughout the world, from the point of view of variety of their natural properties and the differences in the feature of the humans which is moral in character. The consideration of these things is at once very important and also highly stimulating as well. Unless these matters are considered, general judgments about man would scarcely be possible. The comparison of human beings with each other, and the comparison of the human today with the moral state of the human in earlier times, furnishes us with a comprehensive map of the human species. Finally, the condition of the states and nations throughout the world do not depend on accidental causes, such as the deeds and fates of individuals, for example, the sequence of governments, conquests and intrigues between states. The condition of states will rather be considered in relation to what is more constant and the situation of their countries, the nature of their products, customs, industry, trade and population. Kant therefore sets out a range of distinctions- the physical, moral, and political geography is eluded. But the actual analysis is rather more complicated. By the mid 1770s he offers a range of possibilities for the study of various branches of geography :

1. Physical geography: the foundation or ground for other types of geography as well as history – a general study or outline of nature;
2. Mathematical geography: concerned with the measure of the shape, size and motion of the earth, and its situation in the solar system;
3. Moral geography: the relation between moral codes and customs and regions, a kind of spatial differentiation.
4. Political geography: the relation of political systems and political laws to physical features of geography, part of the reason why these are only nominally universal.
5. Commercial geography: concerned with the geographical elements of trade in surplus products.
6. Theological geography: concerned with theological attitudes and principles and their relation to physical features of the landscape; again a form of spatial differentiation.

Physical geography is the physical description of the earth and is the first part of knowledge of the world. Kant divides the philosophy into two parts – the one that deals with pure rational knowledge and one that deals with historical knowledge. The former contains metaphysics of nature and morals, along with pure philosophy and mathematics; the latter

includes history, geography, philology, the humanities, and the empirical knowledge of the natural sciences.

One of the important understandings discussed in his geography includes what is called as moral geography concerning the customs and characters of different peoples, and some extensive discussion of gender, race, history and geography. In a key essay, David Harvey related the lectures to the interest in Kant's cosmopolitanism.

6.2.2 Bernhardus Varenius (1622-1650)

Bernhardus Varenius Published an important geographic reference titled **Geographia generalis** (**General Geography**: 1650). In this volume, Varenius used direct observations and primary measurements to present some new ideas concerning geographic knowledge. This work continued to be a standard geographic reference for about 100 years. Varenius also suggested that the discipline of geography could be subdivided into three distinct branches. The first branch examines the form and dimensions of the Earth. The second sub-discipline deals with tides, climatic variations over time and space, and other variables that are influenced by the cyclical movements of the Sun and moon. Together these two branches form the early beginning of what we collectively now call physical geography. The last branch of geography examined distinct regions on the Earth using comparative cultural studies. Today, this area of knowledge is called cultural geography.

At that time Amsterdam was a busy trading center and the Dutch traders were quite active in distant areas like south east Asia, pacific ocean islands and Japan. They were keen to learn more and more about the a geographical conditions, products, articles of trades, cities, ports, and the socio cultural conditions of the people with whom they were having trade relations. Varenius published a book in 1649 entitled description regni Laponiae et sian.

This book consists of 5 parts. A description of Japan, 2. A translation into Latin of a description of Siam by Schouten. 3. An essay on religions of Japan. 4. Some excerpts from the writings by Leo Africanus on religions in Africa and 6. A short essay on government dealing with places and people.

Varenius made two significant contributions to the development of geography. Firstly, he brought together contemporary knowledge of astronomy and cartography and subjected the different theories of his day to sound critical analysis. Secondly, he divided geography into general and special sections which led to the development of systematic and regional

geography. Thus Varenius was the first scholar who laid the foundation of the dichotomy of systematic vs. regional geography.

The special geography which deals with the special features of different countries and regions may be termed as regional geography while general geography deals with the general laws of the subject. More stress on regional accounts resulted in enormous information and data about the meso and micro areal units. He emphasized the point that general geography depends on regional geography and the regional geography on general geography. Thus they are interdependent. Moreover, the geographic generalis dealt with the whole world as a unit, but was restricted to the physical conditions, which could be understood through natural laws. On the contrary special (regional) geography was primarily intended as a description of individual countries and world regions. It was difficult to establish laws in regional geography where people are involved as their behavior is always unpredictable. The regional geography and its law, nevertheless, help in the formulation of structured ideas, theories, and hypotheses. The regional geography, according to him, also has great utility for government, administration, trade and commerce; while general geography provides the fundamentals which need to be applied in the special geography. In brief, the branching of geography into general and special does not mean that these are opposed to each other; rather they are mutually dependent parts of the whole.

Varenius further divided general geography into the following parts.

1. Absolute: the terrestrial part, in which the earth as a whole, its form, size etc were discussed.
2. Relative or planetary part – concerned with earth's relation to other stars.
3. Comparative part- giving a general description of the earth, the relative location of places on the surface and the principles of navigation.

In the field of astronomy he was in agreement with Copernicus, Kepler, and Galileo, who established the heliocentric universe. The geographers prior to Varenius were mostly the followers of Ptolemy who believed in the geocentric concept of the universe, i.e. The earth is the center of the universe. He was also the first scholar who advocated that the highest temperatures are not recorded in the equatorial belt but along the tropics in the hot deserts of the world. In the opinion of Varenius geography examines surface features, climate, water bodies, forest, deserts, minerals, animals and human inhabitants. The cultural landscape, according to him, includes the description of the inhabitants, their appearance, arts, commerce, culture, language, religion, cities and government.

6.3 LET US SUM UP

Bernhard Veranius and Kant's work on geography is not simply a minor concern, but a key topic that needs to be taken much more seriously by scholars. Bernhardus Varenius contribution has and shall remain as precursors in scientific approaches and philosophy in geography. Kant's way of structuring geographical knowledge and its relation to his thought as a whole is potentially of enduring importance. This importance lies both in the way he understands geography as a counterbalance to history, and in terms of the organization of knowledge. All perceived things are located in logical classifications in space and time. Logic deals first with the; physics with space and time, and of these, geography deals with space – history with time. Geography therefore allows us access to the ordering and categorizing of the world. Indeed, Kant distinguishes geography as the description of the whole world from topography as the description of single place and chorography as that of regions. Orography and hydrography are the description of mountains and water.

He proposed that human knowledge could be organized in three different ways. One way of organizing knowledge was to classify its facts according to the type of objects studied. Accordingly, zoology studies animals, botany examines plants, and geology involves the investigation of rocks. The second way one can study things is according to a temporal dimension. This field of knowledge is of course called history. The last method of organizing knowledge involves understanding facts relative to spatial relationships. This field of knowledge is commonly known as geography. Kant also divided geography into a number of sub-disciplines. He recognized the following six branches: Physical, mathematical, moral, political, commercial, and theological geography.

6.4 KEY WORDS

Celestial Bodies, Nebular hypothesis, Milky Way, *Metaphysical,* apriori concepts, Transcendental Aesthetic, cosmopolitanism

6.5 QUESTIONS:FOR SELF STUDY

1. Explain the chief methodology of geography as proposed by varenius.
2. Explain the chief methodology of geography as proposed by Kant.
3. Explain the scope of geography according to Kant.
4. Discuss the chief scope of geography according to Varenius
5. Critically examine the significance of apriori methodology according to Kant.

6.6 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.

2. Fundamentals of geographical thought: Sudeepta Adhikari, Chaitanya publishing house, Allahabad, 1995.

UNIT : 7 CONTRIBUTION OF MODERN GEOGRAPHERS

Structure

7.0 OBJECTIVES

After Studying this unit you will be able to

- know the Modern geography has undergone a revolutionary change both in form (methodology) and content (concepts and principles) during the 20th century.
- Study what was the nature of research methodology of the earliest geographers who have laid the foundation of modern geographical thought.
- To study the contribution of the founders of modern geography to the growth and development of the concepts and principles of geography.

7.1 INTRODUCTION

After the great age of discover two leading German scholars, Alexander von Humboldt and Carl Ritter made valuable contributions to the fields of basic sciences, humanities and arts. Both were contemporaries, and lived and worked at Berlin for more than three decades. These two scholars are regarded as the founders of modern geography.

7.2 ALEXANDER BON HUMBOLDT

Alexander von Humboldt led the way in the expansion of geography in and outside of Germany. He was a scholar of great versatility, who contributed appreciably to the fields of geology, botany, zoology, physics, chemistry, anatomy, physiology, history, climatology, geomorphology and to all other branches of geography. He travelled about 4000 miles and in all his travels, however short, he made multitudinous observations. He performed all journeys with the most sophisticated instruments and the state of the art instruments of his time such as telescopes, sextants, Cynometers for measuring blueness of the sky, and barometers. With the help of these instruments, he measured accurately the temperatures of air and ground, pressure, winds, latitudes, longitudes, elevations above the sea level, magnetic vibrations, nature of rocks, types of plants and their relations to climate, altitude and human attitude. Charles Darwin described him as "the greatest scientific traveler who ever lived." He is widely respected as one of the founders of modern geography. Alexander von Humboldt's travels, experiments, and knowledge transformed western science in the nineteenth century.

7.2.1 Early life and education

Humboldt was born in Berlin, Germany in 1769. He finished his early education in classical languages and mathematics. He later continued to study botany, geology and

mineralogy at Frankfurt in the University of Gottingen. He was taught by A.G.Wagner the famous geologist – who put forward the hypothesis that all the sedimentary rocks, of the earth had been formed by precipitation under water and had been deposited in layers. Humboldt also attended lectures in physics, chemistry and mining.

7.2.2 Professional career:

In 1792 he was appointed as director of mines in Prussia. He studied the effect of different rocks on magnetic declination and published his first paper in 1793. He became keenly interested in the rock structure of the Alps and visited Bavaria, Austria, Switzerland and Italy. In 1797, he resigned from the government job and planned his journeys to the new and unexplored lands. In Paris, he learned the art of handling various instruments of measurement like sextant, barometers and aneroid barometer.

7.2.3 Adventures and explorations:

When he was 27, Alexander's mother died, leaving him s substantial income from the estate. The following year, he left government service and began to plan travels with Bonpland, a well known botanist. The two went to Madrid and obtained special permission and passports from King Charles II to explore South America.

Once they arrived in South America, Alexander von Humboldt and Bonpland studied the flora, fauna, and topography of the continent. In 1800 von Humboldt mapped over 1700 miles of the Orinco River. This was followed by a trip to the Andes and a climb on Mt. Chimborazo (in modern Ecuador), then believed to be the tallest mountain in the world. They didn't make it to the top due to a wall-like cliff but they did climb to over 18,000 feet in elevation. While on the west coast of South America, von Humboldt measured and discovered the Peruvian Current, which, over the objections of von Humboldt himself, is also known as the Humboldt Current. In 1803 they explored Mexico. Alexander von Humboldt was offered a position in the Mexican cabinet but he refused.

The pair was persuaded to visit Washington, D.C. by an American counselor and they did so. They stayed in Washington for three weeks and von Humboldt had many meetings with Thomas Jefferson and the two became good friends.

Von Humboldt sailed to Paris in 1804 and wrote thirty volumes about his field studies. During his expeditions in the Americas and Europe, he recorded and reported on magnetic declination. He stayed in France for 23 years and met with many other intellectuals on a regular basis.

Von Humboldt's fortunes were ultimately exhausted because of his travels and self-publishing of his reports. In 1827, he returned to Berlin where he obtained a steady income by becoming the advisor to the King of Prussia.

Von Humboldt was later invited to Russia by the tsar and after exploring the nation and describing discoveries such as permafrost; he recommended that Russia establish weather observatories across the country. The stations were established in 1835 and von Humboldt was able to use the data to develop the principle of continentality, that the interiors of continents have more extreme climates due to a lack of moderating influence from the ocean. He also developed the first isotherm map, containing lines of equal average temperatures.

From 1827 to 1828, Alexander von Humboldt gave public lectures in Berlin. The lectures were very popular. As von Humboldt got older, he decided to write everything known about the earth. He called his work *Kosmos* and the first volume was published in 1845, The first volume, a general overview of the universe, the other volumes focused on such topics as man's activities to adjust with the earth, astronomy, and earth and human interaction. Humboldt died in 1859 and the fifth and final volume was published in 1862, post humorously.

Von Humboldt was the last true master but one of the first to bring geography to the world.

One of the contemporaries of Alexander Von Humboldt and a scholar of diversified interests was Carl Ritter. He is also known as one of the founders of modern geographical thought. He was a dedicated fieldworker and believed in empirical research. Moreover, ritter was a teleologist and had a strong belief in god ad not an agnostic like Humboldt.

7.3 CARL RITTER

Another great scholar of that very same age was Carl Ritter. He was also very important to geography. He was a great synthesizer about the knowledge of his surroundings. Ritter encouraged drawing conclusions based on his observations. Ritter decided on a career as a geography teacher. In 1817, we wrote a volume on Africa that became an overnight phenomenon, and in 1820, on the strength of this book, he was appointed to the first university position in geography in Germany, at the University of Berlin.

7.3.1 Conceptual Views "Unity In Diversity":

1. Ritter had made repeated observations of nature. From these observations, he developed the idea of **unity in diversity**. He, like von Humboldt, recognized the great

complexity of nature and within this complexity; however, there was unity because of the interconnectedness of phenomena. According to Ritter: "The earth and its inhabitants stand in the closest mutual relations, and one element cannot be seen in all its phases without the others." , these ideas are very much like those of von Humboldt

2. "New scientific geography"

   To pursue studies of unity in diversity, Ritter advocated the study of geography. He disliked mere description and summaries of facts as an end unto themselves which was existed in the old approach to the subject of geography, instead, he called for a "new" approach to geography. The new approach he meant understanding the interconnections and interrelations in nature and the unity in diversity.

3. Inductive studies:

   Ritter firmly believed that to pursue the new geography, one had to use induction, and this he meant that geographers should continuously make observation until general laws became apparent. He despised deductive studies, in which students made observations of nature as a result of or to try to prove preconceived notions. In this manner, he was very much like von Humboldt, following in the tradition of Aristotle. Strangely, however, Ritter formulated few laws in his writings.

4. Regionalism :

   Like von Humboldt, Ritter also gravitated towards the regional approach to geography. As he was concerned with relations, connections, and interdependence between sets of phenomena in a given area and between separate areas, Ritter was a regionalist. According to him "geography was a kind of physiology and comparative anatomy of the earth: rivers, mountains, glaciers, &c., were so many distinct organs, each with its own appropriate functions; and, as his physical frame is the basis of man, determinative to a large extent of the life of man. In his interpretation of the interrelations between nature and the elements of civilization and culture, he followed geographic determinism. Many of the positions he took in his works found their support in idealist teleology. Ritter attempted to prove that nature has a determining influence on the fortunes of man, which promoted the development of geopolitics. The structure of each country is a leading element in the historic progress of the nation." His ideas in many ways shaped the development of geographic thought in the 19th and early 20th centuries.

He practiced, in other words, **areal differentiation** and his technique is one that remains popular today. Ritter began by defining a particular area as a unit of the physical environment . He then added the human element of that place and finally, he showed how man adapted to and used that habitat. This technique illustrates Ritter's prowess as a teacher, for this he has proven an effective way to organize geographical material. This idea of areal differentiation had a great influence in the early 1900s on an American geographer named **Richard Hartshorne**. Hartshorne was a great admirer of the work of Ritter, he articulated Ritter's ideas, giving it the name "areal differentiation," and introducing it to American geographers at large.

5. Teleology :

Ritter's work has received one major criticism, it is that it was **teleological**, meaning that nature existed for some specific purpose or reason. Ritter was a highly religious person, and this influenced his scholarship, not only did he feel, as did von Humboldt, that nature was an organic whole, unity but also that it had a divine arrangement or plan given by God. As part of this plan, Ritter felt that the earth had been created by God as the home of man. This was different than von Humboldt, as von Humboldt did not consider the role of God in nature

7.3.2 Die Erdkunde

The culmination of Ritter's work was *Die Erdkunde*.

This was intended to be a comparative geography of the world's major regions . 19 volumes were published between 1817 and 1859. The volume on Africa was the first volume of *Die Erdkunde* The work was never completed. It dealt only with Africa and Asia and never got to Europe or the Americas still, this was one of the great works of geography, ranking with von Humboldt's *Kosmos*

7.3.3 Observations on Ritter

To make some observations of Ritter's work, we can say that: Ritter travelled very little outside of Europe; instead, he relied more heavily on other people's observations. He was mainly a human geographer, again in contrast to von Humboldt. Man occupied the center of his studies, while man was only one of the many objects of study to von Humboldt. Because of this, Ritter believed in close ties between geography and history. He did not, however, ignore physical geography, just as von Humboldt did not ignore human geography. Ritter mainly used physical geography to identify habitats of humans or to delineate regions of

settlement. He was more influential as a teacher than von Humboldt, and thus had a more direct influence on the growth of German geography. He received the first chair in geography in any German university. After his death, it was several years before another position that we can identify as a chair in geography was filled as a result of his teaching, he had many students, and as these students matured, the ideas they received from Ritter shaped the overall character of the German geographical tradition

7.4 LET US SUM UP

It explains the basis of the modern geographical approach, there is a part dedicated to the traditional focus on the study of regions, regional variations, and regional comparison as important part of the subject as advocated by Carl Ritter. The founders of modern geography although contemporary and both believed in the scholarly contributions of each other, yet their approaches were distinct which produced different approaches in geography and It also throws light on the plurality of approaches in modern human geography and physical geography with an over view of the future prospects in the discipline. Followed with a scientific approach adopted both by Alexander von Humboldt and Carl Ritter.

7.5 KEY WORDS

Permafrost; Continentality; Kosmas; Inductive; Regionalism; Areal differentiation; Teleology; Die Erdkunde

7.6 QUESTIONS FOR SELF STUDY

1. Explain the similarities and differences in the approaches to the study of geography followed by Alexander Von Humboldt and Carl Ritter.
2. Critically evaluate the reasons to justify that Alexander Von Humboldt and Carl Ritter are the founders of modern geography.
3. Explain the contribution of Alexander Von Humboldt for the development of geography.
4. Explain the contribution of Carl Ritter for the development of geography.

7.7 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.
2. Fundamentals of geographical thought: Sudeepta Adhikari, Chaitanya publishing house, Allahabad, 1995.

UNIT : 8 SCHOOLS OF THOUGHT- GERMAN SCHOOL OF THOUGHT

Structure

8.0 OBJECTIVES

After Studying this unit you will be able to :

- Study The Nature And Growth Of Geography As A Formal Discipline In Germany.
- Study The Conceptual Growth Of Geography In Germany.
- Analyze Determinism As An Important Paradigm Shift In The German School Of Thinking.

8.1 INTRODUCTION

The Development Of Geography In Germany Was Chiefly Focused In Two Areas Viz-a-viz First, Rapid Development In Academic Geography, And Second Emergence Of New Geography Guided By The Darwinism Tradition. This Resulted In The Growth Of Geography As A Systematic Discipline, And Gave Rise To One Of The Most Popular Philosophy In Geography Called As Environmental Determinism. This New Approach Provided The Idea That Man Is A Product Of The Earth And Is Influenced And Dependent For Its Necessities Upon The Geographical Environment In Which He Lives. Therefore The Influence Of Geographical Environment On The Life Of Man Became An Important Subject Matter Of Geography Among Most Of The Geographers Of Germany.

8.2 SOME IMPORTANT GERMAN GEOGRAPHERS

8.2.1 Oscar Peschel (1826–1875) :

Was A German Geographer And Amateur Anthropologist. In 1871 He Became A Full Professor Of The Newly Established Chair Of Geography At The University Of Leipzig. Peschel Is Most Remembered For His Book The Races Of Man: And Their Geographical Distribution (1876) Which Classifies Man Into Seven Races: Australoids, (Papuans), (Melanesians), Mongoloids, Dravidians, Bushmen (Capoids), Negroids And Mediterraneans (Caucasoids).

8.2.2 Alfred Hettner (1859-1941) :

Born in Heidelberg, Germany, He was a German geographer who sought to place geography on a firm philosophical and scientific foundation. He strongly influenced the modern development of geography in Germany.

While completing work on his doctorate at the University of Strasbourg (now in France), Hettner became increasingly absorbed in philosophy. His conception of the nature of geography was rooted in the views of the German philosopher Immanuel Kant, but he was also influenced by a number of the great German geographers. In his view, geography was fundamentally chorology or the study of geographic distributions over the Earth's surface. It was concerned with human interconnection and interaction with the natural environment, but it should also take into account the arrangement, of structure by area, and the Earth's physical phenomena. The study of local differences in phenomena over the Earth's surface was the keynote of this concept.

He visited Chile and Patagonia, and Colombia (1882–84) and, after returning to Germany, published his findings on the Colombian Andes (1888). in 1888 he returned to South America and began more than a year of travels. The hardship and illness endured in the course of this venture resulted in permanent impairment of his ability to walk. Later field researches took him to Russia (1897), North Africa (1911), and Asia (1913–14). While serving as professor at the University of Heidelberg (1899–1928), Hettner became the mentor of a number of students who distinguished themselves as geographers.

For more than 40 years Hettner's principal medium for disseminating his ideas on the scope and methodology of geography was the influential "Geographical Journal", first published in 1899. The first volume of his 1907; "Foundations of Regional Geography" dealt with Europe, but its companion volume, on other regions, did not appear until 1924. He also wrote 4 vol. (1933–35; "Comparative Regional Geography"). One of the major works of geographic literature, the 11-volume "Handbook of Geographical Science", completed in 1940, was his main conception.

8.2.3 FERDINAND VON RICHTHOFEN (1833-1905)

Richthofen was **(1833-1905)** He was born in Silesia, now in Poland and studied in Berlin where he graduated in 1856. From his early life he was interested in travelling. Basically he was a geologist and during 1856 and 1859 he has made investigations of the geology of Tyrol and Transilvania in Alps. He was assigned the task of compiling the combined report and continuing the survey. Richthofen produced an admirable exposition of the Triassic succession in those areas. Which he published and he was appreciated and recognized as one of the first Alpine geologists. he attributed most of the changes in this region in the form of the ground and the tectonic disturbances to slow crustal movements. He also attributed the dolomitic masses and some other parts of the Triassic limestone in the Southern Alps to reef-building corals upon a slowly subsiding sea floor.

In 1860 he served as geologist with a Prussian government mission to Southeast Asia and the Far East, where his travels included an overland journey from Bangkok to Moulmein. In June 1862 he left for California and stayed there for the next six years. In 1868 - 1872 he stayed in China and had traversed every province of the Chinese Empire, and reported the economic resources of China. His reports, published as *Letters on China* (Shanghai, 1870–1872), gave the first indications of the importance of the Shantung coalfield and emphasized the commercial potential of Tsingtao, a port later occupied by the Germans.

In 1872 Richthofen returned to Germany and spent the next thirty-three years mainly in writing and lecturing on China and promoting the study of geography in German universities. In 1883 Richthofen received the chair of geography at Leipzig; In 1886 he was persuaded to return to Berlin as professor of geography, and he held this post until he died.

Richthofen's chief contributions were to Alpine stratigraphy; the geology and geography of China; geomorphology; and geographical methodology. The first volume of his monumental *China: Ergebnisse eigener Reisen und darauf gegründeter Studien* appeared in 1877. It dealt largely with the morphology and geology of Inner Asia and China and their influence on the movements of peoples. The next parts, published between 1882 and 1885, discussed North China and were based mainly on Richthofen's field observations and collections. They included special analyses by August Schenk of the fossil floras and an atlas of twenty-seven hypsographical and twenty-seven geological maps compiled largely from fieldwork and instrumental (aneroid) measurements. Richthofen concluded that the planes of unconformity in the rock series in China were due to marine abrasion on a subsiding landmass. He also described the masses of loess, which he attributed to sub aerial deposition by wind, except in some localities where a "lake loess" indicated an association with water.

Richthofen's geomorphological studies formed part of his geology and the fundamental basis of his geography. The first part of this guide deals with the techniques of field location and observation. The second part discusses at length the interrelationships of geology and surface forms, with considerable detail given to the physical processes involved. The final part contains accounts of soils, rocks, and mountain structures and classifies the main kinds of landforms according to the dominant process in their formation. Thus the genetic aspect predominates, and external forms are used as sub classificatory indices which are unavoidable. This was first document on research methology of field survey and his classification of material and approach was the first truly successful compilation of genetic geomorphology. It immediately became the standard work in Germany for the systematic treatment of landforms and strongly influenced Albrecht Penck's.

Richthofen made outstanding contributions to geographical methodology and to the advancement of geography as an autonomous science. From about 1875 he devoted most of his time to geographical matters and took an interest in all branches of the discipline, although his geological training led him to emphasize the influence of the nature of the land surface upon its inhabitants. Richthofen believed that geography was concerned with the causal interrelationships of all formations and phenomena related to the surface of the earth, rather than the more Comprehensive or earth science approach. It was a science based on field observations and measurements and was always concerned with the assembly of spatial distributions upon a physical background. The method of geographical investigation, however, varied with the scale of the project and aim of the prospector. There were two main fields of geography: special and general. Special geography was descriptive and synthetic and itself fell into two categories: chorography and chorology. Chorography comprised the encyclopaedic registering, within the confines of any area (*Erdraum*), of the systematic assembly of the phenomena and features belonging to the six realms of nature: land, water, atmosphere, plants, animals, and man. There is no necessity of rigorous spatial analysis except to divide the whole or the bigger areas into smaller components or unit areas. Chorology, although descriptive, went beyond chorography because it tried to explain the areal distribution of phenomena by studying their causal and dynamic (spatial) relationships.

The chorological method of special geography led to the second main field of geography—general geography, which dealt primarily with the general study of earthbound phenomena in an abstract or analytical way. It proceeded from the particular to the general and examined phenomena from four points of view or principles: morphology; material nature; dynamic or spatial interconnections; and development (forces and causes of change). Each of these principles would provide a distinctive aspect of general geography, while the last, or genetic, principle would serve to interpret the other three. But Richthofen preferred to apply all four aspects to the study of the six realms of nature. Thereby he brought the analytical approach into closer relationship with chorological studies and unified the numerous branches of geography within a broad physical framework. His scheme, however, was obviously two-sided; and while many of his disciples analyzed spatial arrangements of phenomena on a wide scale, others carried out research in depth on small areas.

Geographers and geomorphologists rightly acclaim him as one of the greatest forces in the modern development of their disciplines.

8.2.4 Johann Heinrich Von Thünen :

(24 June 1783 – 22 September 1850) was a prominent nineteenth century economist. Von Thünen was a north German landland, who in the first volume of his treatise, *The Isolated State* (1826), developed the first serious treatment of spatial economics, connecting it with the theory of rent. The importance lies less in the pattern of land use predicted than in its analytical approach.

Von Thünen developed the basics of the theory of marginal productivity in a mathematically rigorous way, In economics, **von Thünen rent** is an economic rent created by spatial variation or location of a resource. It is 'that which can be earned *above* that which can be earned at the margin of production'.

8.2.5 Walter Christaller :

(April 21, 1893 – March 9, 1969), was a German geographer whose principal contribution to the discipline is Central Place Theory, first published in 1933. This groundbreaking theory was the foundation of the study of cities as systems of cities, rather than simple hierarchies or single entities. Before 1914, Christaller began studies in philosophy and political economics and subsequently served in the army; later, during the twenties, he pursued a variety of occupations. In 1929 he resumed graduate studies that led to his famous dissertation on Central Place Theory in 1933.

At the end of the 1930s he held a short-lived academic appointment, but then joined the Nazi Party in 1940. He moved into government service, in Himmler's SS-Planning and Soil Office, during the Second World War. Christaller's task was to draw up plans for reconfiguring the economic geography of Germany's eastern conquests ("General plan of the East") – primarily Czechoslovakia and Poland, and if successful, Russia itself. Christaller was given special charge of planning occupied Poland, and he did so using his central place theory as an explicit guide.

After the War he joined the Communist Party and became politically active. In addition, he devoted himself to the geography of tourism. From 1950 forward, his Central Place Theory was used to restructure municipal relationships and boundaries in the Federal Republic of Germany and the system is still in place today.

In 1950 Walter Christaller founded together with Paul Gauss and Emil Meynen the German Association of Applied Geography (DVAG).

8.2.6 Friedrich Ratzel (1844–1904) :

Was a German geographer and ethnographer. Ratzel had good education especially in classics. After his school he became a student of zoology at the universities of Heidelberg, Jena and Berlin, finishing in 1868. He studied zoology in 1869, and impressed by Darwin.

After completing his formal education Ratzel began a period of travels that saw him transform from zoologist/biologist to geographer. He began field work in the Mediterranean, writing letters of his experiences. These letters led to a job as a traveling reporter for the "Cologne Journal", which provided him the means for further travel. Ratzel embarked on several expeditions, the lengthiest and most important being his 1874-1875 trip to North America, Cuba, and Mexico. This trip was a turning point in Ratzel's career. He studied the influence of people of German origin in America, especially in the Midwest, as well as other ethnic groups in North America.

He produced a written work of his account in 1876, "Profile of Cities and Cultures in North America", which would help establish the field of cultural geography. According to Ratzel, cities are the best place to study people because life is "blended, compressed, and accelerated" in cities, and they bring out the "greatest, best, most typical aspects of people". Ratzel had traveled to cities such as New York, Boston, Philadelphia, Washington, Richmond, Charleston, New Orleans, and San Francisco.

Upon his return in 1875, Ratzel became a lecturer in geography at the Technical High School in Munich. In 1876, he was promoted to assistant professor, and then rose to full professor in 1880. While at Munich, Ratzel produced several books and established his career as an academician. In 1886, he accepted an appointment at Leipzig. His lectures were widely attended, notably by the influential American geographer Ellen Churchill Semple.

Ratzel produced the foundations of human geography in his two-volume *Anthropogeographie* in 1882 and 1891. This work was misinterpreted by many of his students, creating a number of environmental determinists. He published his work on political geography, *Politische Geographie*, in 1897. It was in this work that Ratzel introduced concepts that contributed to the concept of space and Social Darwinism. His three volume of *The History of Mankind* was published in English in 1896 and contained over 1100 excellent engravings and remarkable chromolithography.

Ratzel continued his work at Leipzig until his sudden death on August 9, 1904 in Ammerland, Germany. Ratzel, a scholar of versatile academic interest, was a staunch German. During the outbreak of Franco-Prussian war in 1870, he joined the Prussian army and was wounded twice during the war.

Influenced by thinkers like Darwin and zoologist Ernst Heinrich Haeckel, he published several papers. Among them is the essay *Lebensraum* (1901) concerning biogeography, creating a foundation for the uniquely German variant of geopolitics: *geopolitik*.

Ratzel's key contribution to *geopolitik* was the expansion on the biological conception of geography, without a static conception of borders. States are instead organic and growing, with borders representing only a temporary stop in their movement. It is not the state proper that is the organism, but the land in its spiritual bond with the people who draw sustenance from it. The expanse of a state's borders is a reflection of the health of the nation.

Ratzel's idea of space would grow out of his organic state conception. This early concept of *lebensraum* was not political or economic, but spiritual and racial nationalist expansion. The *Land* is a historically driving force, pushing peoples with great *energy* to naturally expand. Space, for Ratzel, was a vague concept, theoretically unbounded. *land* was defined by where German peoples live, where other weaker states could serve to support German peoples economically, and where German culture could fertilize other cultures. However, it ought to be noted that Ratzel's concept of *land* was not overtly aggressive, but theorized simply as the natural expansion of strong states into areas controlled by weaker states.

The book for which Ratzel is acknowledged all over the world is 'Anthropogeographie'. It was completed between 1872 to 1899. The main focus of this monumental work is on the effects of different physical features and locations on the style and life of the people.

8.2.7 Alfred Hettner, (1859-1941) :

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8.2.8 Albrecht Penck,

In 1875 he entered the University of Leipzig to study natural sciences. In the same year Otto Torell delivered a forceful lecture at Berlin, which persuaded his audience that the boulder clay of the north European plain had been carried by a continental ice sheet and not by floating ice; he thus vindicated and perpetuated the ideas of A. Bernhardi (1832). Shortly thereafter Penck found and wrote about a northern "basalt" erratic embedded in the diluvium near Leipzig.

At Leipzig, Penck studied chemistry, geology, mineralogy, petrography and botany. In I877 he joined the geological survey of Saxony, and Penck mapped on a scale of 1:25,000 the southeast of Leipzig. In 1879, from the detailed analysis of a sequence of glacial sedimentation that showed alternations of unbedded glacial clay and laminated sands and clays, he postulated at least three main ice advances, or glacial phases, interspersed with two interglacial periods during which rivers had laid down normal, bedded deposits. Penck subsequent investigations into Quaternary geology were especially concerned with Alpine glaciations.

In 1884 Penck was elected to the chair of physical geography at the University of Vienna, he engaged himself in extensive field studies in the Alpine valleys with a view to perfecting a chronology of ice sheet advances and retreats, and dealing with erosion and denudation. Penck subsequently made several journeys through Western Europe and visited

Canada and the United States in 1898, the Balkans and Australia in 1900, and the United States and Mexico in 1904. Before leaving Vienna, he had taught many German and foreign scholars.

In 1906 Penck succeeded Ferdinand von Richthofen in the chair of geography at the University of Berlin. His inaugural lecture dealt with the fundamental importance of fieldwork in geographical studies and as director of the institute for the next twenty years he set a fine example. In the winter of 1908–1909 he and his family visited the United States. Penck taught at Columbia University and lectured at Yale and other universities; he also met G. K. Gilbert in California. They returned to Germany via Hawaii, Japan, North China, and Siberia. (In the same scholar exchange program, W. M. Davis lectured on landforms at Berlin). The last part of *Die Alpen im Eiszeitalter* appeared in 1909; up to this time, and for a few more years, his work at Berlin was virtually an extension of his studies at Vienna.

The outbreak of World War I was a turning point in Penck's thought rather than in his life. Apart from Quaternary problems, which had always interested him, his thinking became more geographical and less geomorphologic. Directing more effort to sociopolitical themes, he showed an increasing interest in ethnographic, cultural, and nationalistic topics. In 1917–1918 he served as rector of the University of Berlin; and his inaugural discourse, was a study of frontiers, especially European. The best frontiers, he thought, coincided with the living space and territory indispensable to the life and security of a state. Germany had in part acquired *land* but unfortunately had failed to retain the entire mineral basin of Lorraine. Now in 1917 Penck hoped that Germany would keep all the territories currently occupied so far as they were indispensable, and that it would further acquire colonies to furnish essential raw materials.

"He used to be liked as much as admired but during the war some of his statements have lessened the esteem formerly felt for him" (*Geographical Review*, **10** [1920], 249). Penck played a considerable role in the revival of German nationalism after World War I; he was, for example, one of the chief advocates of the foundation of the Berlin *school of thought*. The concepts of space, the ethnographic, cultural, and social surveys fostered and undertaken by Penck and others later proved disastrous but were then highly popular in Germany and had honored antecedents in the work of Friedrich Ratzel. Penck thus enjoyed great national esteem . About this time Penck's interests in oceanography yielded their best results. As he was responsible for extending the oceanographic museum at the University of Berlin and was involved in the arrangements for the Meteor Expedition (1925), In 1926 Penck retired from

the chair of geography of Berlin, however, he continued to work on geographical and editorial problems in connection with the geographical institute of the university.

In fact, for the last thirty years of his life he was more a regional geographer and demographer than an earth scientist.books written after his retirement concern Quaternary chronology, cartography, and population problems. His last projects involved the study of the relationship between the potential productivity and possible number of inhabitants per unit area of land mass. During World War II, his house was damaged by bombs and he moved to Prague.

The assessment of Penck's contributions to the earth sciences is complicated by the change in his views. He did not hesitate to accept new theories or to recant his ideas. This development can be illustrated clearly from three facets of his work. First, in his concepts of regional geography he was an early follower of Richthofen. Thus, his "Das deutsche Reich" (1887) superimposed spatial distribution of various phenomena upon a detailed physical base, with the use of new physiographic terms such as foreland. But after 1914 his regional concepts changed rapidly to unit areas of landscape in which the visible repercussion of the natural and socio cultural environment allowed the establishment of core and fringe areas. Man's activities and his acquired traits and inherited characteristics entered more strongly into the spatial relationships. The concept of *space* loomed large with what might be considered a regrettable chauvinistic veneer, and with strong hints at possible expansion and regrets at the non coincidence of political social economic and culture distributions. Second, Penck changed his views considerably on the descriptive analysis of landforms. At first his elaborate empirical descriptions lacked any notable sequential development among the individual forms; but under the influence of Davis, Penck recognized the value of a "cyclic" or sequential progress. After 1918, he rejected Davis' theory and, with his son Walther, he placed the rate and nature of uplift as dominant factors in the analysis of certain landforms. Third, Penck quite early agreed with Suess on the leading principle that secular variations in the relative altitude of land and sea were due to worldwide fluctuations of sea level, rather than to crustal movements. By 1900 Penck had modified his views and had accepted independent crustal movement (regional or local) as a concomitant factor in elevating or depressing coastlines.

Assessing his contribution is complicated also by the wide range of geographical topics that he discussed. He published more than 400 books and articles, and many of the latter were issued separately in book form. Yet his chief scientific writings concerned four branches of the natural sciences: Quaternary geology and chronology geomorphology hydrology, and cartography.

8.2.9 Wladimir Petrovich Köppen :

(September 25, 1846 – June 22, 1940) was a Russian geographer, meteorologist, climatologist and botanist. After studies in St. Petersburg, he spent the bulk of his life and professional career in Germany and Austria. His most notable contribution to science was the development of the Köppen climate classification system, which, with some modifications, is still commonly used. Köppen made significant contributions to several branches of science.

His father Peter Köppen was a noted geographer, historian and ethnographer of ancient Russian cultures, and an important contributor to intellectual exchanges between western European slavists and Russian scientists. Wladimir attended secondary school in Simferopol, Crimea and began his studies of botany in 1864 at the University of St. Petersburg. He frequently travelled to his family's estate on the Crimean coast from St. Petersburg, and to and from Simferopol, in the interior of the peninsula. The floral and geographical diversity of the Crimean peninsula, and the starker geographical transitions between the capital and his home, did much to awaken an interest in the relationship between climate and the natural world. In 1867, he transferred to the University of Heidelberg and defended his doctorate dissertation on the effects of temperature on plant growth at the University of Leipzig in 1870.

Between 1872 and 1873 Köppen was employed in the Russian meteorological service. In 1875, he moved back to Germany and became the chief of the new Division of Marine Meteorology at the German naval observatory (Deutsche Seewarte) based in Hamburg. There he was responsible for establishing a weather forecasting service for the northwestern part of Germany and the adjacent sea areas. After four years of service, he was able to move on to his primary interest – fundamental research – and left the meteorological office.

Köppen began a systematic study of the climate and also experimented with balloons to obtain data from upper layers of the atmosphere. In 1884, he published the first version of his map of climatic zones in which the seasonal temperature ranges were plotted. This work led to the development of the Köppen climate classification system around 1900, which he kept improving for the rest of his life. The full version of his system appeared first in 1918 and, after several modifications, the final version was published in 1936.

Apart from the description of various climate types, he was acquainted with paleoclimatology as well. In 1924 he and his son-in-law Alfred Wegener published a paper called *Die Klimate der Geologischen Vorzeit* (The climates of the geological past) providing crucial support to the Milankoviæ theory on ice ages.

Towards the end of his life, Köppen cooperated with the German climatologist Rudolf Geiger to produce a five-volume work, *Handbuch der Klimatologie* (Handbook of Climatology). This was never completed, but several parts, three of them by Köppen, were published. After Köppen's death in 1940, Geiger continued to work on modifications to the climate classification system.

Köppen was a prolific scientist, producing more than 500 papers, and retained his intellectual curiosity and wide range of interests throughout his life. In 1890 he co-authored the first cloud atlas. Alongside scientific pursuits, he was actively involved in social questions, devoting much time and energy to such problems of land-use and school reform and nutrition for the underprivileged.

8.3 LET US SUM UP

The major contributions of the German geographers can be described in the fields of physical geography, climatology, urban geography and systematic geography. The geographical philosophies have greatly influenced the global politics especially during the first and second world wars. However in the present times the growth of the subject is mostly directed towards spatial approaches and application of GIS and remote sensing.

8.4 KEYWORDS

Philosophical works, Astronomy, Celestial bodies school of thought, chronology, Floral.

8.5 QUESTIONS FOR SELF STUDY

1. Discuss the emergence of one of the major dichotomies and philosophies in geography by the German school of thought.
2. Explain the major contribution of German geographers in the field of physical geography.
3. Critically evaluate the impact of German geographers in the global politics in the 20th century.
4. Explain the theory of social Darwinism and critically examine its significance.

8.6 FURTHER READING

1. Evolution of geographical thought: Majid Husain, Rawat Publications, Jaipur and New Delhi 1995.
2. Fundamentals of geographical thought: Sudeepta Adhikari, Chaitanya publishing house, Allahabad, 1995.

UNIT : 9 FRENCH SCHOOL OF THOUGHT

Structure

9.0 OBJECTIVES

After studying this unit, you will be able to

- Introduce the French School of thought for the devolopment of Geography.
- French Scholars were also pioneers next to Germans who had immensely contributed for the development of geography.
- The French school of thought was lead by **Vidal de la Blache** and followed by his students of first and second generations
- who have worked in the departments of various universities of France. Thus, the French school of thought is largely the study of vidalion tradition itself.

9.1 INTRODUCTION

France shared the intellectual knowledge of Europe throughout 18 and 19th centuries. The works of Alexander Von Humbolt and Carl Ritter of Germans have influenced the philosophers of France, the neibouring country. France was one of the major centres of philosophy. So, the academic devolopments and ideologies evolved in France have not only influenced the European countries, but also have impact world over. The approaches and methodologies devoloped in France for the geographical studies were followed in many countries and continued even up to present generations in one or the other form.

9.2 FRENCH GEOGRAPHERS

The French School consists of several prominent geographers. Lucien Febrve, Vidal de la blache, Jean Bruhnes, Emmanuel de Martonne, Demongean are the importat geographers of French School.

Philippe Buache, a cartographer has divided the land areas for the first time into hierarchial units or order based an drainage system rather than political boundaries. During the later part of 19th century French historians have took leadership for the devolopment of geography. Even the Darwinism has also played a significant role and the study of human societies by the French philosophers were made on the basis of Darwinism. The Regional tradition of Ritter has great impact on French geographers. *Federic le play* a sociologist, born in Normandy, had studied metullurgy and later concentrated for the study of Sociology. He had travelled throughout Europe to understand social life and organisation. He had published several books on Europe. He had initiated the formula place-work and family. It

means the place of living, nature of occupation and the social life are closely related. This concept was borrowed by Geddes of Britain which forms the basis of regional planning. Le play had also published many monographs on the life of Europeans. According to him the life of Europeans was evolved in three different environments namely steppes, coastal lands and forest lands.

Lucien Febrve : He is the forerunner of Vidal de la Blache. Febrve was a historian and his major work is *"A Geographical introduction to History"* published in 1905. The works of Febrve strongly influenced the geographical Traditions of France. He had coined the term *"Possibilism"*. It is a widely accepted concept for studying man- Environment relationship. According to Febrve *"There are no necessities and controls in nature; but there are many opportunities. Man has to choose from these opportunities according to his requirements and capabilities". He states that; "Nature does not drive man along a particular road but it offers a number of opportunities from among which man is free to select."* Febrve has considered "man as a geographical agent", as he can change the environment through his experiences. Thus Febrve had initiated human oriented possibilism through the study of the geographical influences on history. The concept of possibilism had largely directed the geographical studies in France.

Vidal de la Blache: (1848-1918) Growth of geography in France has been shaped by the work of one man namely Vidal dela Blache. He was dominent not only through out his generation but also influenced the next generation through his students. Joerg while writing on French contributions in the book "Geography during the 20th century ed. by G.Taylor states that *"the French contributions are that of Vidal or his students or students of his students"*. This statement clearly indicate the significant role of Vidal for the devolopment of geography in France.

In the beginning of his career Vidal taught geography at the university of Nancy from 1872-1877. He founded a new periodical called *Annals de Geographie*. In 1894 he published *Atlas Generale Vidal de la Blache*. Later he moved to the university of Sorbonne where he remained there as professor of geography till his death in 1918.

Concept of Possibilism : Vidal was a strong opponent and critique of Ratzelian concept of Environmental Determinism. He advocated the concept of possibilism postulated by Febrve. His basic approach of studying man-Environment was that nature sets limits and offers possibilities for human settlements but the way man reacts and adjusts to the conditions of nature depends on his own traditional way of living. Blache states that *"man participate*

in the game of nature." He had approved the writings of Lucien Febrve. He considered the earth's surface as a "terrestral organism".

Vidal Coined the term *Genre de vie* which means *"mode of human life"*. According to him human mode of life is an effect of total influences natural, historic and social factors. He had studied life of various tribes which were living in the same climatic conditions and has observed differences. He states that these differences were related to historic and social factors rather than geographic.

According to Vidal "*a plant is deep rooted to the ground in adaptation to nature, but man is not a plant. He will play both passive and active role. He can construct buildings, change the landscape."* Thus the relation between man- environment is ever changing. In course of time man-nature adapt to each other like a *'snail and shell'* and it is impossible to separate them.

Regional Tradition : Vidal has laid strong foundations to the Regional studies. He considered geography as an idiographic science. His famous book *tableau de la Geographie de la France* (Geography of the table land of France) is a classic regional study. He divided France into smaller regional units called '*pays*' and has exibited that each one has different agricultural features in relation to soil and water supply conditions. Influenced by Vidal many geographers produced regional manographs of different pays. However he had opposed the idea of demarcation of regions based on drainage basin. Further he states that small regions are highly suitable for studies and to train geographers. This tradition is still prevalent in France.

Terrestrial Unity : Vidal has devoloped the idea of terrestrial unity. He considered the earth as a single unit, whose parts are co-ordinated where each phenomena follow a definite sequence in accordance with general laws. The idea of terrestrial unity was borrowed from the plant geography. It was first conceived by Humbolt and he had considered the general appearance of vegetation as one of the most important characteristic feature of a region. Every element of the earth's environment is well adopted to its locality which is well reflected in the vegetation types, height, size, position of leaves, root devolopment etc. The animals and man are capable of moving. Even they are well associated with into the environment. Thus plants, animals and man are found in mutual interrelationship. Vidal has published several papers in his own *'Journal Annals de Geography'*. All these were compiled and published in 1921 posthumously as **Principles of Human geography** by his son in law Emmanuel de Mortonne. As a result of efforts by Vidal over many decades Geography was

firmly established in France. In 1921 there were 16 departments of geography in 16 universities and all the chairs were occupied by the pupils of Vidal. Thus geography in France owes much to the contributions and efforts of Vidal.

Jean Bruhnes : (1869) He was a student of Vidal. Born in 1869, he had studied History and Geography. He was much influenced by vidalian tradition. His famous book is Human geography published in 1910. According to him human geography is confined to the study of

- Un productive occupation of soil.
- Things Connected with the conquest of plant and animal worlds.
- Destructive or robbery economy.

Jean Bruhnes emphasized two principles, namely principle of activity and principle of interaction. In the principle of activity he states that every physical and cultural phenomena are in the state of constant change. Every thing is either growing or diminishing, expanding or shrinking and nothing is stable and static. Every phenomena including mountains, rivers, ice sheets, sea, land are continuously changing. So one must have this principle of activity to understand the phenomena.

The idea of interaction was borrowed from La Blache. Bruhnes assumed that geographical phenomena - both physical and cultural are closely related to each other and they must be studied in their mutual relationship. It is similar to terristrial unity which later inspired regional synthesis. In support of principle of interaction Bruhnes examined the relationship between animals and cultivated plants.

Emmanuel de Martonne : (1873-1955) He was a student of Vidal and later became his son-in-law. He was the leader of French geographers up to the end of II world war. He was born in 1873 and later became a professor at the university of Sorbonne, the chair which was vacant after vidal. He had established *Institute of geography* in 1923. He had also served the International Geographic Union. De Martonne concentrated on physical geography of central Europe. He inspired many French geographers to work in the field of physical Geography. His famous work are *Traite de Geographic Physique* and *La France Physique.*

Other Geographers : Geography in the later period was developed in France parallel to Germany through the contributions of students of vidal. Albert Demangeon, a student of Vidal was associated with Sorbanne university. He has concentrated on human geography. His major works are Habitation-Rurale-en-France in 1920. La Habitate Rurale in 1927. He

had considered Human geography as the study of human groups in relation to geographical millieu. R.Blanchard, studied under vidal has worked at Grenoble where he has founded **Institute of Alpine Geography**, for the study of mountains. He had intensively studied French Alps & has written 12 volumes. One of the most outstanding works of Blanchard is Regional Geography of Europe. In which he had continued regional tradition of vidal. Maximilien Sorre (M.Sorre) was also studied under Vidal. He was more interested in *'Genre-de-vie'*. He dedicated his life to the geography of man. His four volumed work was published between 1947-52.

9.3 LET US SUM UP

The French contributions to geographers were iniciated by the famous historian Lucien Febrve who coined the term possibilism. Vidal de la Blache further elaborated and advocated possibilism and he had established a new school opposite to environmental determinism of Ratzelian school of Germany. Vidal had immensely contributed for regional studies through the study of 'pays'. The concept of Terriestial Unity was echoed in the works of later geographers of France. Thus, with possibilism a new approach to the study of man-Environment relationship, a new school was also established around the Vidalian concepts.

9.4 KEY WORDS

Lucien Febrve, Vidal de la Blache, Possibilism, Pays, Terrestrial Unity, Jean Bruhnes, De Martornne, Raoul Blanchard.

9.5 QUESTIONS FOR SELF STUDY

1. Give an account of the contributions of French school to the devolopment of geography.
2. Explain the contributions of Vidal-de-la Blache for the devolopment of geography in France.

9.6 FURTHER READINGS

1. P.E.James and C.F.Jones : American Geography : Inventory and prospects, 1954 Syracuse.
2. M.Husain - Evolution of Geographical thought, 1999, Rawat Jaipur.
3. Arildt-Holt-Jenson-Geography-its History and concept, Rawat.
4. Dickinson RE- Makers of Modern Geography, 1969, Mathuen & Co, London
5. Woolridge and East - The Spirit and purpose geography 1951, London.
6. Lalita Rana - Geographical thought, 2008, Concepts, New Delhi.

UNIT : 10 BRITISH SCHOOL OF THOUGHT

Structure

10.0 OBJECTIVES

After studying this unit, you will be able to

- Introduce the contributions of British Geographers.
- Analyses the Development of geography took place in Britain very late after Germans and French
- Explain the Regional studies, Geomorphology, land use studies, Political Geography, Economic Geography were the important branches which were contributed by the British Geographers.
- Introduce the British geographers as well as their major contributions.

10.1 INTRODUCTION

Geographical studies and writings gained momentum in the mainland of Europe. Both Germans and French were the pioneers of development of Geography. In addition to Geographical studies, even there were methodological debates among the Germans and French. However, geography has entered into Britian very late, as they were concentrated on exploration and colonisation of lands. It was only in the early part of 20th century Geography was introduced as an academic discipline in the oldest universities of Britain namely Oxford and Cambridge. **The Royal Geographical society** of London was established in 1830 to encourage the study of Geography. **Charles Darwin** through his theory of *'Evolution of Species'* not only revolutionalised Biological Sciences, but even geography was also influenced by it. Darwin became a member of Royal Geographical Society of London. The well known British Sociologist and Philosopher Herbert Spencer wrote Books "Principles of Biology" and "The Principles of Sociology". He Coined the term *"Survival of the fittest"*, adopting the natural principles to the study of Human Society which was called *"Social Darwinism"*. It is this theory which was widely used by British as well as other Europeans to defend their colonisation of Asiatic and African lands.

10.2 IMPORTANT BRITISH GEOGRAPHERS

From the beginning of 20th century many British Geographers have contributed to the development of the discipline. Patrick Geddes, Halford Mackinder, A.J.Herbertson, L.D.Stamp, OHK Spate and David Harvey are the most significant Geographers of Britain. Even the famous Australian Geographer, Griffith Taylor is also a British by origin and later migrated to Australia.

10.2.1 Patrick Geddes :

The well known Scottish biologist and botonist Patrick Geddes (1854-1932) has contributed to the field of Urban planning . He was responsible for introducing the concept of regional planning. His famous wordings place, work and folk was considered as place, Economy and family which were the basic concepts of regional planning, as all these phenomena are well related to each other. Geddes through his urban studies has demonstrated that urban social processes and spatial form are interrelated. He had strongly influenced American Urban theorist Lewis Mumford.

10.2.2 Halford Mackinder : (1861-1947)

He is considered as the founder of Geography in Britain as well as British School of thought. In 1886 Mackinder became a member of Royal Geographical Society and in 1887 he was appointed by the university of Oxford as the first professor of Geography in Britain. He has put efforts to estalish teaching of Geography in many universities of Britain. He has also put efforts in founding 'Reading University'.

Mackinder is well known for his **'Heart Land'** theory. He tried to demonstrate complex ideas with simple expressions. The works of Mackinder has attracted academicians towards the study of Geography. So he is well known as the founder of British School of thought. Mackinder was also well trained in History. He had published the book "Britain and the British seas" in 1902. Later he had published many articles and books in which he had advocated the famous heartland theory. The theory was published in three stages. These are;

1 Article titled "The Geographical pivot of history, in 1904.

2 The Book titled "The democratic ideals of reality, in 1919.

3 Article titled "The round world and Winning of peace" in 1943.

Mackinder assumed that Asia, Europe and Northern part of Africa consists larger land area of the world which he called the 'World Island'. It includes ? of land and ? of population of the world. The world island according to Mackinder consists of three parts. These are;

i Pivot area or heartland.

ii Inner crescent or marginal crescent.

iii Outer crescent or insular crescent.

The Pivot area or heartland is the land of Central and Northern Asia extending from Volga in the west to Siberia in the east. It is a formidable, well protected area bounded by the mountains in the south and west and the cold frozen ocean in the north. Thus it is a well protected land which Mackinder called the "Heart land" of the world which is almost inaccessible from any side. The inner crescent is the second part of the world Island. It includes all the land attached to the heart land. Western Europe, India, China and mainland of South East Asia are in the inner crescent. However Islands such as Britain, Japan, Indonesia are not in the inner crescent. The inner crescent is highly populated and it has the advantage of sea coast and maritime trade. The outer crescent includes the remaining land encircling the heart land and the inner crescent. It includes North America, South America, Southern part of Africa, Australia and all marginal islands.

Mackinder states that the heart land is naturally well protected and it is surrounded by large population with diversified economy. He states that;

"Who rules East Europe, Commands Heartland,

Who rules heartland commands the world island,

Who rules the world island commands the world".

Thus, Mackinder states that one who rules the pivot area or heartland naturally control the entire world. Later his theory was criticised and Mackinder has modified his theory in his article "The round world and the winning peace" published in the foreign affairs Journal in 1943.

10.2.3 A.J. Herbertson : (1865-1915)

He was a great scholar of Geography. After obtaining Ph.D in 1898, Herbertson published his *"Atlas of meteorology"* in 1899. He joined Oxford University in 1899 where he remained till his death. He wrote the famous book *"The Major natural regions of the world"* in 1905. He was the founder editor of the *"Geographical Journal"* and also secretary of Geographical Association during 1901-1915. He promoted the regional concept which is well dipicted in his book natural regions of the world.

10.2.4 L.D.Stamp : (1898-1966)

He was one of the most influencial Geographer in the first half of the twentieth century. Born in London, Stamp studied Geology and wrote many papers on the Geology of Britain, Belgium and France. He got his honours degree in Geography in 1921 and also got D.sc in

1923 for his research publications. He was appointed as professor of Geography and Geology at the Rangoon University and later moved to London School of Economics. In 1949 he was conferred the title 'Sir' and became Sir Dudley Stamp.

Stamp was instrumental for the preparation of ordnance survey map of Britain. He prepared the land use map of Britain. He classified the land use into seven fold which is followed even today. Based on these maps Stamp wrote the book *"The Land of Britain; It's use and misuse"* in 1947. He had also wrote many books of Geography particularly for the students of India, Britain, Africa and Australia. He had strongly opposed Quantitative revolution of Geography.

10.2.5 O.H.K.Spate : (1911-2000)

He is well known for his role in establishing Geography in many countries of the world. He studied Geography in the Cambridge University. He was appointed as Professor in the Rangoon University in 1937 and wrote many papers an the Geography of Burma. After independence of Indian Sub continent he moved to London School of Economics. He wrote the book "Changing face of Asia". In 1954 he published India and Pakistan- A General and regional Geography. He strongly opposed Quantitative Revolution in Geography.

10.2.6 David Harvey :

He is the most important British Origin Geographer of the present generation. He is a prolific writer and produced good number of books. In the beginning of his career Harvey strongly supported quantitative revolution along with Chorley and Peter Haggett. Later he moved away from the quantitative methods and he was influenced by marxism. At present he is the Professor of Anthropology in the University of Newyork, USA. *'Explanation in Geography'* in a renowed work of Harvey related to the methodology and philosophy of geography. Other important books of Harvey includes social justice and the city.

10.3 LET US SUM UP

Though Geography was started late in Britain, it has significantly contributed for its development. Charles Darwin, Herbert Spencer, Geddes, L.D. Stamp, OHK Spate, Mackinder, Chisholm, Herbertson and David Harvey have laid philosophical foundation of Geography in Britain. In the present generation Peter Hagget, Chorley, H.Robinson and many others have continued its development. Geography is taught almost in every University of Britain. The theory of Evolution, Heartland theory, Quantitative revolution, landuse planning were the major concepts of British Geographers.

10.4 KEY WORDS

British School of thought, land use planning, Evolution of Species, Charles Darwin, Social Darwinism, Patrick Geddes, Mackinder's Hartland theory, Herbertson, L.D.Stamp, OHK Spate, David Harvey.

10.5 QUESTIONS FOR SELF STUDY

i Give an account of the British School of thought for the devolopment of Geography.

ii Write a brief note on the contributions of H. Mackinder.

iii Write a brief note on the heart land theory of Mackinder.

10.6 FURTHER READING

1. M.Husain - Evolution of Geographical thought, 1999, Rawat Jaipur.
2. Arildt-Holt-Jenson-Geography-its History and concept, Rawat.
3. Dickinson RE- Makers of Modern Geography, 1969, Mathuen & Co, London
4. Woolridge and East - The Spirit and purpose geography 1951, London
5. Lalita Rana - Geographical thought, 2008, Concepts, New Delhi.

UNIT : 11 AMERICAN SCHOOL OF THOUGHT

Structure

11.0 OBJECTIVES

After studying this unit, you will be able to

- Introduces the American school of thought.
- Growth and development of Geography in the USA, important scholars and their major contributions are also discussed.
- Analyze developments with respect to the development of geography in the USA.

11.1 INTRODUCTION

The intellectual devolopments in the continent of Europe have produced their replica in the USA as there were strong inherited relationship between the lands on either side of North Atlantic ocean. The devolopments in Germany with reference to geography in particular have strong influences particularly. At that time Germany and Britain were the important centers of learning in the world to which the students were attracted. In some universities of USA like Harvard, Yale, Dartmouth, Columbia, Princeton and Pennsulvania new courses of geography were taught. **Arnold Guyot** of Princeton was the first Professor of geography in the USA. He was a follower of Ritter and a telelogist. He considered the continents as the abode of man and the theatre for the action of human societies. He was interested in the study of physical world and explored Applalachian mountains and also collected meteorological data of several stations. In 1870 physical Geography was started in the Harvard University and William Morris Davis, the well known geomorphologist was appointed as Assistant Professor of Geography. Besides, the American Geographical Society was founded in 1851 which had encouraged the devolopment of geography. Shaler, a well known Geomorphologist and teacher of Davis wrote the book "nature and man in America", in which he had discussed the effects of physical conditions of the earth on the evolution of organic life. In addition, the book also discusses geographical influences as man. At this point of time it was believed in general that the life of man on the earth was completly controlled by the physical environment. In this Background W.M.Davis emerged as the most important geomorphologist. He became popular through his theory of **cycle of erosion** and he is aptly considered the **father of geography in the USA.**

11.2 IMPORTANT CONTRIBUTORS

The history of geography in the USA is spanning over three centuries during which many geographers have contributed for its devolopment. In the early part of American school, it was almost a replica of European contributors as many of them were largely influenced by the European scholars. However in the later part American geographers have almost dominated geographical development. Many new theories, concepts and laws were advocated by the Americans. Louis Agassiz, Arnold Guyot, Davis, Mark Jefferson, Isaiah Bowman, E.C.Semple, Carl O Sauer, EllsWorth, Huntington, Rollin D Sallisbury, Barrows H.H. were well known and have laid foundation to the American School of thought.

11.2.1 Louis Agassiz (1807-1873) :

Born in switzerland and studied Zoology, he was specialised in the classification of living and fossil fish (ichthyology). He had studied Brazilian fish for which he got his Ph.D degree in 1829. Later he joined the newly formed Academy of natural History at Switzerland in 1832. In 1840 he published "Study of Glaciers" in two valumes. In this book he had discussed the movement of Glaciers and introduced the concept of ***'ice Age'***. He wrote that large sheet of ice resembling those now existing in Green land, once covered all the countries of northern and central Europe, in which unstratified gravel is found. Later Agassiz moved to America as professor of Geology and Zoology at Harvard University. Agassiz also introduced the term "*Erratic rock*".

11.2.2 W.M.Davis (1850-1934) :

William Morris Davis was an eminent Geomorphologist. He worked hard to get recognition and reputation to geography throughout 19th and early part of 20th century. As such quite often he is considered the founder of American geography. Born in Philadelphia he graduated from the Harvard University. He studied geology under shaler, Agassiz and later became assistant to shaler. In 1885 he became Asst. Professor of physical geography. In 1904 the founded the Association of American Geographers (AAG). The great geographers of America such as Mark Jefferson, Isaiah Bowman, Ells Worth Huntington and Ellen Semple were the students of Davis. For a long time he remained as inspiration to geographers in America.

The most important contribution of W.M.Davis was the concept '*cycle of erosion*'. It was presented in 1889 in the International Geographical Congress held in Berlin. It is also known as "Geomorphological Cycle", or "topographical cycle". Much influenced by the

Darwin's theory, Davis tried to explain time evolution of land forms. Davis postulated that the land forms are the result of structure, process and stage. He had explained that the land forms changes sequentially in accordance with time. Thus he proposed time dependent cycle of erosion. Even the concept of natural selection of Darwin was also adopted by Davis which is clearly evident in his words "it seems most probable, that the many pre existent streams in each river basin concentrated their water in a single channel of overflow and that this one channel survives - a fine example of natural selection". Davis has borrowed many words from the works of powell and Gilbert such as Gradation, Base level and incorporated meaningfully in his theory.

In the later years of his life, Davis has also included human part within the ambit of geography. The core of geography he defined as the study of relationship between physical environment and human behaviour. He had used the term "Ontography' in contrast to physical earth, which refers to include the study of human groups, plants and animals.

Thus Davis emerged as one of the greatest geographer of his generation. His works had profound influence not only in America but also in the entire english speaking lands all over the world. Even German and French schools were also influenced by Davis for several decades. The cycle of erosion has remained a paradigm for many decades unchallenged. His Ontography paradigm developed into ecological paradigm. Environment determinism concept which was most dominent during the days of Davis has also helped for the popularity of Davisian concept.

11.2.3 Ellen Churchill Semple (1863-1932) :

She was born in Louis Ville, Kentucky. She was the first well known female geographer of the USA and also she was the first lady teacher of Clark University. Semple was a strong supporter of Ratzelian concept of Environmental determinism. She was mainly responsible for the development of Human geography as well as environment determinism concept in America. She was the professor of Antropo geography between 1921 to 1932 at Clark University. She had authored some well known books of which **"American history and its geographical conditions"**(1903) **"Influences of geographical environment"**(1911) and the **"Geography of the mediterrannean region"**(1931) were most important. Semple was the president of AAG in 1921. She was conferred many honourary degrees and medals. She is well known for her narration of Man-Environment relationship. She writes that "Man is a product of the earth's surface. This means not merely that he is a child of the earth, dust of her dust; but that the earth has mothered him, fed him, set him tasks, directed his thoughts

confronted him difficulties that have strengthened his body and sharpened his wits, given him his problem of naigation or irrigation and at the same time whispered hints for their solution". Her writings have profound influence and have helped for the devolopment of geography.

11.2.4 Ellsworth Huntington (1876-1947) :

Ellsworth Huntington was the most important academician of his time, a prolific and creative writer. Sometimes he is compared with the his contemporary famous historian Toynbee. He tried to interpret the influence of climate on human life scientifically. He travelled widely in North Africa, Europe and South America. He was a strong supporter of environmental determinism. He tried to explain the mode of life of human groups in relation to climate. Thus he is known for showing the effects of climate on human life. He had stated that "**A rational understanding of history requires a good knowledge of changing physical background upon which the historical events occurs. As historians are lacking of geographical knowledge, their synthesis of historical events are not highly meaningful**". He explained the outmigration of nomads from central Asia was largely caused by climatic change which led to the conquest of India, China and Eastern Europe by the Mangols.

The most important books of Huntington are "Pulse of Asia"(1907), "Civilization and Climate"(1915), and Principles of Human geography(1920). In the Pulse of Asia he wrote that the drying of pastures due to climate change has led to the migration of people from Central Asia. He had elaborated the relation between climate and civilization and stated that civilizations could devolop only in the areas of stimulating weather. In contrast tropical hot climates are unsuitable for the growth of civilizations. Principles of Human geography was a popular book not only among geographers but also even with academicians of other disciplines.

11.2.5 Carl O Sauer :

He was one of the leading geographer of America who had influenced on the entire discipline during his life time. Throughout his academic life he was associated with the university of California, Berkely and Contributed for the study of cultural landscape. So, Sauer and his followers are also better known as **'Berkely School of thought'.**

Sauer has opposed the concept of environmental determinism of Ratzel and Semple. He studied the diffusion of plants and animals, origin and dispersal of Agriculture. His concentration was on the study of changing cultural landscape and the processes which induce them. He was interested in the use of historical method in geography. According to Sauer it

is the role of man which makes geography disassociate itself from geology. The term cultural Landscape was advocated by Carl Sauer in his paper "Morphology of cultural landscape" in 1925. The term cultural landscape was originally introduced by Passarge and Otto Schluter of Germany. Sauer put forward the concept of cultural landscape as an alternative to environmental determinism. This concept explain the interrelations between humans and environment. He had stated that the geographic study of any region must begin with a study of its entire previous geography, chronologically arranged. In his opinion every landscape has forms, structure and functions. Sauer has explained that geographer should seek the processes behind the evolution of cultural landscape and reconstruct the stages of its formation. Sauer asserted that geography is basically anthropogenic. Culture is the agent, the natural area is the medium and the cultural landscape is the result. Under the influence of a given culture, itself changing through the time, the landscape under goes devolopment passing through phases and probably reaching ultimately the end of its cycle of devolopment. Even the cultural lands also get rejuvinated with the introduction of an alien culture.

In the later part, American geography was influenced by the Quantitative revolution. This new trend was led by many American geographers. Many laws and theories were introduced into the discipline. Richard Hartshorne in his perspectives on the nature of geography has introduced the concept of 'areal differentiation'. Whittlesey propogated the concept of 'Sequent Occupance', BGL Berry, James, Bunge, Davies, D.M.Smith and many others have contributed for the devolopment of geography in America.

11.3 LET US SUM UP

The contributions of American school of thought have great significance in the development of contemperary geography. The traditions and themes propogated in Europe have found support in the American Universities. Deterministic approach was followed in the beginning, but possibilian was deep rooted in the later decades. Quantitative revolution beginning from America had worldwide impact as a new tool in geographical research and analysis. Cycle of erosion, cultural landscape, sequent occupance, urban landuse models, Megalopolis, rank-size rule, climatic classification by Thornthwait and Threwartha, Crop concentration, Crop diversification are some of the important concepts evolved in America.

11.4 KEY WORDS

W.M.Davis, Cycle of erosion, Shaler, Guyot, Louis Agassiz, Ice age, Erratic Rock, E.C.Semple, Huntington, Carl Sauer, Cultural landscape, Berkeley school of thought, sequent occupanace, A real differentiation.

11.5 QUESTIONS FOR SELF STUDY

1. Explain the contributions of American School of thought.
2. Describe the contributions of Semple and Huntington.
3. Write short notes on cycle of erosion, cultural landscape.

11.6 FURTHRER READING

1. P.E.James and C.F.Jones : American Geography : Inventory and prospects, 1954 Syracuse.
2. M.Husain - Evolution of Geographical thought, 1999, Rawat Jaipur.
3. Arildt-Holt-Jenson-Geography-its History and concept, Rawat.
4. Dickinson RE- Makers of Modern Geography, 1969, Mathuen & Co, London
5. Woolridge and East - The Spirit and purpose geography 1951, London.
6. Lalita Rana - Geographical thought, 2008, Concepts, New Delhi.

UNIT : 12 DUALISM AND DICHOTOMY

i. General or Systematic v/s Regional Geography

ii. Physical v/s Human Geography

Structure

12.0 OBJECTIVES

After studying this unit, you will be able to

- introduces one of the important feature of geography, i.e.dualism and dichotomy.
- discusses historical evolution of these approaches and also important causes for them.
- better understanding of the earth's surface and its inhabitants the field of the discipline.

12.1 INTRODUCTION

Throughout the history of the discipline, Geographers were confronted with the problem of methodology and approaches rather than the field and philosophy of the discipline. The domain of geography undoubtedly is the earth's surface. However the methodological problems were evolved from the earliest period of the discipline starting from the ancient Greeks and Romans. It is largely because, the field of geography, the earth's surface is very wide and its environment as well as inhabitants differs from one region to another. So, it is impossible for a geographer to get on the first hand information of the earth's surface completly.

In the beginning geographers were largely concerned with the physical phenomena of the earth's surface such as mountains, rivers, volcanoes, seas etc. However there were some descriptions of people also. Herodotus explained many tribes in relation to their environment. Eratosthenes tried to measure earth's circumference and also explained *'Ecumene'*. Strabo described the known world of his time. Ptolemy prepared the known world map based on the map of Eratosthenes. He defined geography as a "Science of map making". Thus there was no uniformity in the geographical studies even during the ancient period.

12.2 DUALISM AND DICHOTOMY

'Dualism' means difference of views, controvercy and debate regarding an issue. Dichotomy is parallel to dualism which means dividing. In geography methodological debates are common and deep rooted in its long history. These are closely associated with the understanding of the earth's surface and its inhabitants. The earth's surface was gradually explored, its length, width size and shape were gradually visualized. The environment and mode of human life in different parts were gradually known to the intellectual world. Thus, knowledge regarding the earth and its inhabitants were acquired by the geographers over a long period. Besides methodology and approaches of other disciplines were also borrowed

and the geographical studies were enriched. Even the concepts, laws and theories of other sister disciplines were also adopted in geographical studies. Geography was divided into various divisions based on field, content and methodologies. This phenomena of dividing and debating in geography is called dualism and dichotomy.

Major Divisions : Some of the most important dualistic approaches in geography are;

i. General geography versus special or Regional geography.

ii. Physical geography versus Human geography.

iii. Historical versus contemporary geography.

iv. Quatitative versus Qualitative geography.

v. Deterministic versus possibilistic approaches.

vi. Inductive versus Deductive approaches.

Among the dualism of geography General versus regional geography, as well as physical versus Human geography are well known and these have almost divided geography into two vertical divisions.

12.3 GENERAL VERSUS REGIONAL GEOGRAPHY :

It is one of the oldest divisions of geography and continues even in the contemporary studies. General geography refers to the study of any material of the earth's surface with reference to the entire world. For example rivers of the world, population of the world, world patterns of Agriculture etc. General geography is also known as '*nomothetic method*' or 'Systematic method'. In contrast study of a particular area in detail is known as *particular* or *regional* or '*idiographic* method'. In geography both these approaches are used to understand the earth's surface i.e the domain of geography.

The dualistic nature of geography was first recorded by Bernhard Varenius, a German geographer working at Amsterdam. He had collected large amount of materials from the sailors and wrote his famous Book *'Geographia Generalis'* in 1650. Considering the vast amount of material from the geographical discoveries, he divided the book into a three sections;

i	Terrestrial section	-	deals with shape and size of the earth, continents, seas, atmophere etc.,
ii	The cosmic section	-	deals with the relation between the earth and other heavenly bodies,
iii	Comparative section	-	deals with different places of the world.

The book of varenius is most significant for its methodology rather than its content. Varenius divided large amount of material of the earth's surface for the purpose of study into two divisions. These are;

i. General geography.

ii. Special geography.

Varenius considered that these two divisions are mutually interdependent parts of the whole. General geography refers to the study of the entire world. It is aimed at understanding of the phenomena of the entire earth's surface. It is also known as *'systematic'* study or 'nomothetic' method. The word *'nomothetic'* means *'law deriving'*. General study of the earth's surface with reference to a particular phenomena enable geographers to formulate laws and theories of universal application. For example population is very sparse in the cold and mountain areas, temperature decreases with increasing of attitude. The study of world relief, climates, Economy, population are some of the examples of general geography which is also called systemtic or universal geography. Physical geography of the world and World Human geography books are typical examples for general geography. In general geography various features of the earth are discussed and their distributions are analysed. Urban geography, settlement geography, cultural geography, Agricultural geography, climatology are some of the systematic fields of geography which reflects the nature of general geography.

Special geography or regional geography on the other hand is a synthesis of a particular part of the earth's surface such as Asia, Europe, India, Karnataka, the Gangetic plains, the coastal plains of karnataka or cauvery basin etc. Thus, a detailed analysis of an area either as a organic whole or unity or with reference to particular phenomena such as landuse, economy of that particular region is an example for regional studies.

Regional method is a unique geographical methodology which was even followed by ancient Greeks and Romans who tried to describe a part of the known world. Greeks have coined the term 'choro' to refer area or a region. The famous Roman geographer Strabo's works are typical example for regional studies who described different parts of the known earth's surface in several volumes. So he is considered as the **founder of regional geography**. Immanuel Kant described geography as a *'Chorological Science'* considering that geography is largely meant for the study of different areas to understand their uniqueness with reference to the nature of surrounding areas.

After classical period, Archibald Geiki of Britain has studied physical geography of the earth's surface. Mary Somer Ville of Britain published her book physiography which also included biosphere as part of it. The book was reprinted later in the name physical geography. Darwin's theory has greatly influenced even the physical geography. Genetic study has become a common approach. Even the land forms were also studied following the process of their evolution.

The word Geomorphology was coined by Albert penk. Davis published his "Geographical cycle or cycle of erosion in 1899. Koeppen presented the climatic classification and added enough material for the study of climatic patterns of the world. (1884-1918) Dukuchaive has classified the soils of the world based on their genetic formation. Huxley wrote the book physiography in 1877. The challenger expedition has got voluminous material regarding the oceans also. Develoment of ecology by Haeckel.E has given a new dimension for the understanding of physical geography. All these devolopments since 1859, the year in which Darwin's theory was published have contributed for the devolopment of physical geography.

Alfred Hettner of Germany has defined geography as an idiographic or regional science, than general. Immanuel Kant classified history and geography. He considered history as a chronological science and geography 'as a chorological science'. The regional tendency continued even in the modern period. Richard Hartshorne of America in his "The nature of geography"(1939) has stated that the philosophy of geography is the systematic study of the *'areal differentiation'* of the earth's surface. In these words he states that geography is basically the study of variable character of the earth's surface and understanding the unique character of each part of the earth's surface. He had strongly advocated the regional method of geography. As such regional method is also known as Kant-Hettner and Hartshrone tradition. Vidal de la blache has further popularised regional method for the study of Genre de vie(mode of life)through the study of small regions called *'Pays'*.

Schafer an American economist turned into a geographer has strongly criticised Regional tradition in geography in his paper *"Exceptionalism in geography* : A methodological examination" in 1953. He criticised that it is impossible to formulate laws and theories through regional methods. As such he criticised the limitations of geography to consider it as a science. Schafer's criticism has identified the limitations of geography. As such many young geographers of later period have followed quantitative methods for the study of the earth's surface in general and tried to formulate laws, models and theories to make geography more a science than a branch of humanities.

Varenius concept of special geography is concerned with the study of interrelationship that exists among the phenomena of an aea. Carl Ritter gave more emphasis on Regional geography Ratzel in his study of human societies has also followed regional method for the understanding of man-environmental relationship.

Complementary Nature of General and Regional Studies

Like all other sciences, geographical studies also requires principles and theories which are applicable universally. These are evolved only with the systematic studies or general geography through its various branches of physical as well as human geography. Both natural as well as cultural phenomena of the earth's surface and processes are studied intensively. Cultural geography, climatology, geomorphology, Bio-geography etc, deal with distinct aspects of the phenomena of earth's surface and evolve relevant laws and theories. These laws and theories are required even in the study of Regional geography. Thus, both general and regional geography are aimed at understanding of earth's surface at different dimensions. Regional studies will become more meaningful with the application of general laws, statements and theories which are formulated with the nomothetic studies. These laws, models and theories are tested with regional studies to understand their applicability. Thus, general geography and regional geography are complementary and interrelated.

12.4 PHYSICAL GEOGRAPHY VERSUS HUMAN GEOGRAPHY

Based on the content, geography is divided into two main divisions namely Physical Geography and Human Geography. Physical Geography is generally described as the physical foundation of the discipline. It is concerned with the study of natural environment of the earth consisting of four components namely lithosphere, atmosphere, hydrosphere and biosphere. The study of distribution and process of these components is the main objective of physical geography. It is the oldest division and studied since the beginning of the discipline.

The study of physical geography has longest history than any other branches of geography. It has its roots in the ancient Greeko-Roman period. Both Humbolt and Ritter of Germany were concerned with natural landscape. Ritter concentrated on terrestrial unity. Since physical geography is concerned with the study of natural environment is also known as 'natural geography'.

Human Geography : Human geography on the other hand was evolved only in the recent period and it is a recent sprout of the oldest trunk of geography. Fredrich Ratzel introduced the term Human geography, through the publication of his book Anthropo geography in 1882.

His followers particularly Semple, Huntington in America and Vidal de la Blache in France have laid conceptual foundations for the study of Human geography. Initially environmental determinism approach was followed for the analysis of man-environment relationship. Later the concept of 'possibilism' which was introduced by Lucien Febrve and Vidal became popular and this approach has provided a new dimension to the study of Human geography.

Human geography is concerned with the study of man-Environment relationship. In the words of semple "Human geography is the study of ever changing relation between the unstable earth and unresting man". Vidal de la Blache has stated that "Human geography is a recent sprout from the vulnerable trank of geography". The term "Human geography" was introduced by Ratzel to study "Man-Environment relationship".

In course of time several branches were evolved from human geography and they were developed into systematic branches. Economic Geography was introduced in 1882 (Gotz). Commercial geography was introduced by chisholm through the publication of his book 'commercial geography'. *'Political Geography'* was coined by Ratzel in 1897 and it was further developed by the contributions of Mackinder, Haushofer and Mahan. Settlement geography and Urban geography were also developed under the influence of Sociology and Economics. The ecological tradition was widely followed in human geography. As such human geography was also termed as "Human ecology" by H.H.Barrows in 1923. Later whittlesey introduced the term 'Sequent Occupance' in 1929 in relation to the dominance of an alien culture on a weak traditional culture.

Human geography in its history of evolution has moved with different social sciences and has become more of human oriented. The cultural aspects of man were intensively studied under the influence of ***Anthropology.*** Even the material of *Sociology* were analysed from the geographical point of view. As such human geography is also known as 'Social Geography' as well as 'Cultural Geography'. Various theories and models of social sciences have been adopted effectively in the studies of different branches of human geography.

Physical geography on the other hand is concerned with the study of the entire earth's surface. In the earliest period the entire field was of geographers but later several systematic branches of science have been evolved and developed into separate disciplines. Geomorphology, Geology, Oceanography or Marine science, Climatology, Meterology, Pedology, Botany and Zoology were developed into systematic sciences. At present, physical geography includes the marginal field of most of the natural sciences for the understanding of the earth's surface in totality. It is borrowing the results of research works of its sister disciplines

for the understanding of its field. As such many models and theories of natural sciences have been adopted by physical geography. Thus, it is moving with the natural sciences in constrast to the human orientation of Human geography.

The division of geography into physical and human has helped for the development of the discipline. At the same time there were many controversies regarding the content of the subject. Faigive has asked "whether the central theme of geography man verses rest or Organic versus in-organic. Woolridge and East have considered the dualism an unimportant question. "A division of the subject in to physical geography and human geography is a false dichotomy. But they have to be considered as two sides of the subject". Mackinder (1861-1947) in 1887 has considered only one field with the unity of the two divisions. However dualism exists in geography, the field is divided in to two separate divisions namely physical and human geography. They exists complementary to each other as they deal their material in relation to other one.

12.5 LET US SUM UP

Geography has dualistic approaches and these have actually divided the field vertically into debating divisions which is called 'dichotomy'. The most important dualisms are "General geography versus special or regional geography", "Physical geography versus Human geography". The dualistic approaches in geography have been evolved in the long history of the discipline. Varenius has clearly divided geography into general geography and special geography based as the method of analysis. The division of geography into physical and Human geography is based on the content. Physical geography is concerned with the natural features of the earth's surface where as human geography deals with Man-Environment relationship. However it should be noted that these divisions are complementary to each other and both the divisions are essential for better understanding of geography, the science of earth's surface.

12.6 KEY WORDS

Dualism, Dichotomy, General geography, Special geography, idiographic science, Ecumene, Varenius, nomothetic, Systematic method, choro, chrological science, areal differentiation, Pays, Exceptionalism in geography, Human Ecology, Sequent occupance.

12.7 QUESTIONS FOR SELF STUDY

1 What is dualism and dichotomy? Explain the development of dualism in geography.

2 Explain the dualism of General versus Regional geography.

3 Give an account of the dualism of Physical and Human geography.

12.8 FURTHER READINGS

1. P.E.James and C.F.Jones : American Geography : Inventory and prospects, 1954 Syracuse.
2. M.Husain - Evolution of Geographical thought, 1999, Rawat Jaipur.
3. Arildt-Holt-Jenson-Geography-its History and concept, Rawat.
4. Dickinson RE- Makers of Modern Geography, 1969, Mathuen & Co, London
5. Woolridge and East - The Spirit and purpose geography 1951, London.
6. Lalita Rana - Geographical thought, 2008, Concepts, New Delhi.

UNIT : 13 Recent Trends in Geography
Quantitative Revolution in Geography

Structure

13.0 OBJECTIVES

After studying this unit, you will be able to

- Identify the revolutionary change in the past fifty years.
- introduce these new tools and trends.
- Explain the methodological debates among the Geographers have resulted in the enrichment of the discipline.
- Analyse the recent trends along with quantitative revolution and its impact on Geography.

13.1 INTRODUCTION

Regional tradition was most dominent method of Geographical description till 1950's. Richard Hart Shorne in his 'Nature of Geography' published in 1939 has stated that geography is a 'unique science'. It deals with 'Areal differentiation' of the earth's surface as each one of the areas are unique in their features and consequently man-Environment relationship also vary in every part. So application of theories of universal nature, formulation of laws and models are not possible in geography. Further he states that the discipline deals with an enormous range of phenomena and must provide a congenial home for many different kinds of practitioners. The idea of regions provides the essential unifying theme that integrates the diverse sub disciplines of geography. The highest form of Geographer's art is the production of evocative descriptions that facilitate an understanding and an appreciation of the regions.

This argument of Hart Shorne was strongly criticised by Schaefer F.K. an American economist turned into a geographer. In his paper *"Exceptionalism in geography; A methodological Examination;* (1953) he raised questions about the validity of geography as a science. Schafer's article was not only a reciprocation to Hartshorne's chorological view point, it was also a call for scientific approach in geography based on the search for Geographical laws. He criticised the 'exceptional' view of geography and argued that like all disciplines, even geography must seek order in the spatial distribution and evolve laws and theories through scientific research. He had stated that without the formulation of laws a discipline cannot be recognised as a science. As a result of Schaefer-Hartshorne debate geographers followed scientific methods. They tried to develop laws and theories relevent to their field of study. This tendency brought about a distinctive shift in emphasis from regional to systematic studies. It means that geographic studies there after began increasingly viewed in a nomothetic perspective. It also involved a shift from areal to locational studies, from

absolute to relative locations. This new paradigm was followed by the younger generations. Many laws, like distance decay, spatial diffusion, migration laws, gravity model, consumer behaviour and movements, rank-size rule, etc., were evolved by geographers. This paradigm shift was largely due to shift of geography from descriptive to quantitative and analytical approaches.

13.2 QUANTITATIVE REVOLUTION IN GEOGRAPHY

Geography after 1950's has undergone a sea change. It has confronted with the problems of generalisations, models and theory building. These developments were already existed in many physical sciences and also in few social sciences particularly like economic. After the second world war geographers came to know the importance of mathematical language than the language of mere literature and descriptions. The descriptive geography was discarded in place of which more importance was given for abstract models and theories. According to Yeats "*Geography can be regarded as a science concerned with the rational devolopment, testing of theories that can explain and predict* the spatial *distribution and location of various characteristics on the surface of the earth*". As such geographers started using and applying quantitative tools and techniques in place of qualitative generalisation. This phenomenal change in the history of geography is discribed as *"Quantitative Revolution"* which has become the most important methodology in 1960's.

The term quantitative revolution was first used by ***Ian Burton*** 1963 in the article *"the quantitative revolution and theoretical geography"*, published in the *Canadian geographer.* The effect of this revolution has great impact on the nature of geographical research. Quantitative Revolution in geography is closely related with the shift of social sciences related to human geography. In the first phase of development human geography was more associated with history and Anthropology. As such historical methods and Anthropological traditions were followed in geographical descriptions. In the second phase geography came into contact with economics and sociology. As a result the locational analysis approach was introduced in to geographical enquiry. Geography has even encroached the field of economics and sociology. At the same time even the methodologies such as quantitative techniques, theory and model building were also borrowed for precise measurement of geographical variables. Thus, geographical studies have adopted more and more of statistical and mathematical tools for their analysis.

The quantitative revolution has directed the geographical research in a new direction. Hitherto geographers were concerned with mere description and generalization. There mere even were comparative descriptions and 'Cause and Effect' descriptions. The new quantitative approach required field studies, collection of primary data, utilization of secondary data, and adoption of sampling procedures. This has rationalised the method of geographical research. The results obtained were tested with hypotheses, law or with a model for the justification of the results.

13.3 APPLICATION OF QUANTITATIVE TECHNIQUES

Quantitative techniques were highly useful for geographical studies. Every branch of geography have adopted new methods of analysis. However the following are some of the important fields of large scale quantitative applications.

i. Locational Theories :

Till the beggining of 20th century geographers had complexity as they didn't had any theories and laws like other natural and social sciences. Thus, geography was largely confined to the descriptive methods. In order to overcome this drawback geographers started to interpret the organisation of space and to establish laws and theories. In the first attempt the locational theories were borrowed from economics and adopted in geographical studies. The classical location theories such as the land-use pattern of "Isolated State" of Johann Heinrich Von Thunen in 1826 and the Least Transportation cost theory of Alfred Weber in 1909, were introduced into geography. Later the theories of Hoover, Losch and Isard (Regional Analysis) were also followed. Walter Christaller was the first geographer to make a major contribution to location theory with his famous work 'Central Places in Southern Germany' in 1933. He studied under Weber and was inspired by economic theories. Basically he was an economist worked under the supervision of Robert Gradmann, a geographer, who followed ideographic tradition. He had tried to explain the pattern and hierarchy of central places with the application of statistical methods. Later many more techniques like nearest neibourhood techniques, Gravity and potential models were also introduced.

ii. Urban Geography :

The study of Urban areas in geography was adopted under the influence of sociology as well as economics. It was devoloped into a separate branch with the contributions of many geographers like Jean Gottman and Dickinson. In the begging Urban Sociology

and Urban Economics were developed into separate branches. Later Christaller has initiated systematic study of settlements pattern and their heisarchical order. Urban location theories particularly Harries, Ullman systematized the sub discipline of urban geography. Multiple-Nuelei theory of Harris and ullman elaborated the importance of Urban geography. After 1960's consumer behaviour, traffic flow, urban land-use pattern, land values, living standards, spacing of settlements, Urban hinterland, Urban fringe, umland were studied with the application of statistical methods.

iii. Agricultural Geography :

Agricultural geography was mainly descriptive till the beginning quantitative revolution. However in the later stage quantitative methods were widely adopted. Diffusion of innovations were studied in the Lund University of Sweden under the leadership of Hagerstrand(1953). Carl-Sauer has initiated this kind of studies in his book "Origin and dispersal of plants" in a descriptive manner. The Sociologists particularly E.M. Rogers has taken up the process of diffusion in his book "Diffusion of Innovations". Hagerstrand has studied the diffusion of innovations and the results were published in his book "Innovation Diffusion as a spatial process" (1967). He had adopted Monte-Carlo simulation method and mean probability field for the prediction of patters of diffusion. Similar studies were also taken up in America Particularly by Morrill, Brown and Cox. In addition in place of regionalization of agriculture (whittlesey,1929) crop concentration, Crop combination analysis were introduced with the application of quantitative models.

Many branches of geography even including geomorphology have adopted statistics as a means of analysis. Climatology was more quantified with the studies like 'analysis of rainfall variability'(crowe) "A new view of some familiar Indian rainfalls"(Mathew) were some of the examples of statistical methods in climatology. The maps and diagrams were replaced by statistical models. Even Cartographic techniques have made use of the results of quantitative applications for the preparation of maps.

13.4 IMPORTANT STATISTICAL METHODS

Geographers have adopted a wide range of statistical methods.

- Time - Series method was adopted for the study of trend such as production and temporal changes of any spatial phenomena.
- Factor – Analysis, Multi-variate Analysis were followed for differentiating of spatial phenomena.

- Nearest neighbourhood techniques are widely used in the study of settlement.
- Newton's Gravitation model has been adopted in the study of human migration, consumer behaviour and distribution of Urban Centers.
- Network analysis and graph theoretic models were used in the study of Transport network.
- Simple correlation, regression analysis, T-Test and F-Test were used for the study of spatio-Temporal phenomena.

13.5 LIMITATIONS

The quantitative revolution has reached the stage of marginal utility in the decade of 1970's. According to Johnston(1979) that "The leaders of quantitative school didn't study the philosophy which they were adopting quantitative tools very intensively". William Bunge in his theoretical geography (1962) has stated "Geography is the science of spatial relations and inter-relations, Geometry is the mathematics of space and so geometry is the language of geography". Peter Hagget, Charley have continued statistical methods in Britain. But the tendency gradually declined because ;

- The quantification tendency didn't relate means and ends effectively.
- The correlation method failed to explain man-environment relation effectively
- Everything was quantified during this period irrespective of its need.
- Behaviour of people were beyond the reach of quantification. So quantitative revolution was almost became stagnant.
- In addition there is many opposition for complete quantification.

Dudley Stamp in his article *'Quality and Quantity in Geography'* has stated that "the term quantitative Revolution is a civil war, it is more or less a religion to its followers, its golden calf is computer". These developments have brought explanation as an important means in the studies of geography. In the words of O.H.K.Spate "to the maximum extent Quantitative Methods make only 50 percent of geography, where as the remaining is left to the perception and explanation. Gradually behavioural studies were developed in contrast to quantitative revolution.

13.6 LET US SUM UP

The new trend of geography was largely initiated by the debate between schaefer ad Hartshorne. Geographers of younger generation have adopted statistical and mathematics tools for their research. This new trend was described quantitative revolution by Ian Burton in 1963. Rise of positivism has also fovoured application of statistical tools. Almost every branch of geography have adopted these methods for precise measurement of space and accurate analysis. It has also brought new concepts like relative space, relative distance etc., With all these geography has become more scientific oriented explanations rather than descriptive.

13.7 KEY WORDS

Quantitative revolution, exceptionalism in geography, Aerial differentialism, Scaefer-Hartshorne debate, locational theories.

13.8 QUESTIONS FOR SELF STUDY

1. Explain the new trends and approaches of geography.
2. Give an account of quantitative revolution in geography.
3. Quantitative revolution has brought a new dimension; but it has its own limitations - Explain.

13.9 FURTHER READING

1. P.E.James and C.F.Jones : American Geography : Inventory and prospects, 1954 Syracuse.
2. M.Husain - Evolution of Geographical thought, 1999, Rawat Jaipur.
3. Arildt-Holt-Jenson-Geography-its History and concept, Rawat.
4. Dickinson RE- Makers of Modern Geography, 1969, Mathuen & Co, London
5. Woolridge and East - The Spirit and purpose geography 1951, London.
6. Lalita Rana - Geographical thought, 2008, Concepts, New Delhi.

UNIT : 14 PARADIGMS IN GEOGRAPHY

Structure

14.0 OBJECTIVES

After studying this unit, you will be able to

- Introduce the changing paradigms in geography.
- Identify the application of paradigms concept helps to understand the major corner stones of the discipline.
- Identify the major philosophical stages of geography.
- Understand the important philosophical issues that have gained important in different periods.

14.1 INTRODUCTION

'Paradigm' is an English word meaning pattern, exemplar or a model. Thomos Kuhn in his short monograph 'the structure of scientific revolutions in 1962 has introduced it for the study of history of sciences which passes through one generation to another and aquires the scientific achievements of each generation and also guiding the direction of its research works continuously. Kuhn has called it 'Paradigm of Science'. In his words "Science is not a well regulated activity where each generation automatically builds up on the results achieved by earlier workers; in constrast sometimes it is fast and in some other times the growth is very slow. Thus the growth of any discipline has the stages of rapid and slow developments. This trend is related to paradigms. In his words "Paradigms are the universally recognized scientific achievements that for a time proved model problems and solution to a community of practitioners".

In simple terms paradigms may be stated as a model of scientific tasks and methods which regulates the research of a discipline. The paradigms directs the research works like what is to be studied; How to be studied; What method should be followed; What techniques are useful for the study a particular problem? etc., In the words of Peter Hagget the "Paradigms are like super models".

14.2 PARADIGM OF SCIENCE

Kuhn while explaining the growth of science advocated that development of science consists of several stages. There will be plateau followed by sudden rapid development. These stages have been termed as;

1. Pre paradigm phase
2. Professionalism phase
3. Paradigm phase-1
4. Crisis phase with revolution
5. Paradigm phase-2
6. Crisis phase with revolution
7. Paradigm phase-3 and So on.

1. Pre paradigm phase : All sciences share a part of the total knowledge. Every discipline in the beginning is lacking of well defined field and methodology. The study of science is unsystematic as it overlap with other branches of knowledge. Kuhn has termed this stage as 'pre paradigm stage'. In this stage different schools emerge around individual scholars. Every school claims superiority over others and each one contradict with other schools.

2. Stage of Professionalism : It is the stage in which the practitioners define their field clearly and begins to deal with it intensively. As the domain and methodology are clearly defined the discipline is separated from others. One of the schools established in the preparadigm stage gets significance which is capable of getting answer to the prevailing problems. This school is recognized and the school evolve methodologies and analysis of study which is followed by the researchers. The new methods and analystical procedures becomes the guidelines for researchers.

3. Paradigm phase-1 – One of the schools of professional stage in course of time get more recognition and Importance. Other arguments are gradually discarded. The methodology and analysis of the significant school becomes paradigm and all other research works are in accordance with the paradigm. It is also called 'normal science'.

4. Crisis phase with Revolution : Devolopment of every science reach the stage of crisis after each paradigm. During the phase of paradigm the researchers follows established methods, traditions and also select a subject relevant to the accepted norms. As such there is a monotony of research topics, methods and even results. It is called plateau without any new developments. Some of the problems remains unsolved by the paradigms or else the researchers may go in search of new directions due to the monotony of research. So, a new may be established with new methods and issues.

In such cases a new paradigm in established which attracts research workers of new generation. The new paradigm may be either opposite or an improvement over the old one. Usually there will be debates of issues contradictory to each other. Kuhn described this as *'Crisis Stage'*

In the crisis phase, the research material, methodology and data analysis is reviewed with a fresh outlook. In the light of new paradigm, earlier research works are reviewed and modified if necessary. In this course even a new theory may be established. Some of the questions unsolved in the previous paradigm stage are analysed to get answer for them. If the new paradigm is capable of answering unsolved earlier questions it will get recognition and popularity. It replaces the old one and attract research workers who continues to establish a new trend and the discipline develops rapidly.

The crisis phase in also called *'revolutionary phase'* as it solves the previous unsolved questions and gets more popularity and also encourage the researchers to follow the new paradigm to get a relevant answers for their research issues. The entire new generation follows the new tradition resulting in the development of the discipline. Thus, every *crisis phase results in the establishment of a new 'paradigm'.*

This kind of scientific development is continuous and each paradigm is followed by a crisis phase and that itself evolves a new paradigm. Sometimes both the old and new paradigms continues to exist parallel to each other. Usually the new paradigm is more scientific and effective which is followed by the younger generation and it is more recognized. It directs the research works of new generation.

Kuhn had explained the course of scientific development in different stages with different phases of paradigm. It helped to explain the history of different disciplines. In any university the numbers of candidates registered for research is in accordance with the conceptual development of the concerned discipline. The disciplines, in the words of Kuhn which gets simplified and popular theories usually attracts more researchers.

14.3 CHANGING PARADIGMS IN GEOGRAPHY

Geography is one of the oldest discipline and its earliar history is abscure in the antiquity. Even its history is not continuous. There are many ups and downs in its long course of development which even stretches to 7th century B.C. In the light of Kuhn's model few paradigms may be clearly identified in geography which are interrupted by the crisis phases. The following are the important paradigms of geography.

- Preparadigm Stage : Geographers have considered the history of geographers up to the publication of Darwins theory in 1859 as preparadigm stage. Immannel Kant explained the field of geography separating it from history. During the ancient and middle ages Greeks, Roman, Arabs and many others have contributed for geography. Carl Ritter has continued the study of history and geography together and treated them as inseperable. Even the works of Humbolt had compilation of information of various disciplines.
- Stage of professionalism in geography : It is marked with the development of German and French schools which had developed parallel to each other German school advocated environmental determinism. In contrast French school propagated possibilism. Both these schools were more popular and geography was firmly established among other scientific disciplines. Many research works were carried out, its field and methodology were well defined.
- Stage of paradigm : After initial development of environmental determinism and possibilism schools, lead by Ratzel and Vidal respectively the research works in geography were directed by these traditions. Both determinism and possibilism have become paradigms which became the guide lines for researchers Environment determinism was most simple and more popular. Geographers have followed this approach and also comparative method for the study of man-environment relationship. As the studies were almost similar they have reached the stage of plateau.
- Crisis phase and Revolution : Monotony of deterministic studies with descriptive method were questioned in the debate between Hartshorne and Schaefer. Schaefer questioned 'the exceptionalism in geography' and advocated for scientific research than mere description. This has lead to quantitative revolution and new trend of geography. The quantitative revolution began in 1960's has far reaching effect on the methodology of the discipline. The tradition of data collection and analysis has become essential part of geographical research. Application of quantitative methods gave a new direction to the discipline. Like all other sciences geographical studies have also concentrated on evolving laws, theories and model building.
- Paradigm -2 : Quantitative revolution : It is one of the most important revolution evolved from the Schaefer – Hartshorne debate regarding methodological approaches in geography. Nomothetic methods of study with the collection of data analysis and interpretations were adopted by the geographers. Mathematics and statistics have

become the language of geographers. Many sophisticated statistical methods like multivariate analysis, graph theory, matrices were also adopted by geographers. Appplication of quantitative techniques has become almost a religion to its followers. Thus geography has become more of mathematical and statistical methods. Rise of positivism has also favoured quantitative revolution.

- Crissis phase and revolution – 2 : Application of quantitative techniques have brought drastic changes in geography. These tools enabled the researchers for precise measurement of spatio-temporal data and interpret them. Geography has aquired all the qualities of a science. However this paradigm has reached plateau with monotony with same formulas, results and analysis. At the same time, the quantitative techniques could not measure all spatial phenomena such as man-environment relationship which is highly variable. So many geographers have followed behavioural approach which has become a new paradigm in geography.

In additional to behaviouralism there are many other approaches were evolved in geography. These are used in different stage of analysis and evaluation. Marxism, humanism, gender studies are some of the current issues in geography. Thus, 'Paradigm' is no longer an abcure term and it is now widely used to mean exemplar or to describe a radical change from the normal course. 'Geographic information system' which was evolved from the quantitative revolution has become a new tool of geographical analysis. Computer application has become a new trend in geography aided by GIS and Remote sensing.

14.4 LET US SUM UP

'Paradigm' concept was introduced by Kuhn to explain the course of development of science. It explains that every science evolves and develops in different stages. At some stages the development is rapid and in others it is slow. Paradigm is like a model which directs the research studies of a generation in particular direction. Each paradigm later reach monotony and crisis phase to produce a new paradigm. Geography is also evolved through many paradigm stages in its long history.

14.5 KEY WORDS

Paradigm, professionalism, Researcher, Crisis phase and revolution,

Schaefer – Hartshorne debate.

14.6 QUESTIONS FOR SELF STUDY

1. Define paradigm and explain the stages of scientific growth.
2. Explain the paradigms of scientific growth with reference to geography.
3. Give an account of paradigms of geography.

14.7 FURTHER READING

1. David Harvey : Explanation in geography, Arnold publishers, New Delhi.
2. P.E.James and C.F.Jones : American Geography : Inventory and prospects, 1954 Syracuse.
3. M.Husain - Evolution of Geographical thought, 1999, Rawat Jaipur.
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UNIT : 15 MODELS IN GEOGRAPHY-BHAVIOURAL APPROACH IN GEOGRAPHY

Structure

15.0 OBJECTIVES

After studying this unit, you will be able to

- Introduces models in geography.
- Identify the quantitative techniques for precise measurement of spatio-temporal phenomena.
- Identify the trends is formulation of laws, theories and models.
- Models are simple represention of reality.
- Identify the best model of the earth Vonthunen's landuse model, urban landuse models, Peter Gould's graphical solution to the choice of crops are some of the examples of models.

15.1 INTRODUCTION

Behavioural approach is one of the recent devolopments in geography. The quantitative revolution which had attracted the younger generation of geography has helped to formulate laws, theories and models to explain the complex phenomena in a simple manner. Positivism and statistical tools were largely based on the decisions of economic man. However these models had very little applicability with respect to man-Environment relationship which varies even from one person to another, one group to another, one community to another and so on. Some of the models and theories were in adequate to explain the spatial organisation of human environment. At the same time the quantitative techniques could not explain the behaviour of people living in different and uncertain environment. The native dweller of the flood prone region, with any amount of risk does not leave his habitat. Human behaviour, a to large extent depends on how the people understand and think about their environment. As such wolpert states that 'maximisation of profit' alone is not the critisis for the behaviour and it is depending as various other phenomena which are perceived by man and he acts in accordance with his perception of environment and situation.

15.2 MEANING OF MODELS

The debate between schaefer and Hartshorne with regard to the nature of geography, criticism of Schaefer with regard to exceptionalism of geography, and its uniques have resulted in the acceptance of nomothetic approach, application of quantitative techniques with collection of spatio-temporal data and analysis by the younger generation of geography. Thus descriptive

method was discarded for its monotony and quantitative methods were introduced. Mathematics and statistics became the language of geographers. Geographers tried to formulate laws, theories and models for the explanation of complex spatial phenomena in a simple manner. It is one of the major changes that geography has witnessed with quantitative revolution. Nomothetic method was found highly result oriented. Though distribution of spatial phenomena appears to be haphazard "there is hidden order within chaos." The aim of geography is to explain the spatial order of geographical phenomena. Thus geography has acquired scientific dimension following new methods of research and with the beginning of search for spatial order.

Models are one of the important features of modern geography. In the words of Harvey "the quest for models is a re current theme in research and it has become very fashionable in geographic research". Model building is a scientific trend which is concerned with simplification, reduction, Concretization, Theory formulation and testing with explanation of the real world phenomena.

The term model is defined in a number of ways. In the simplest form "a model is the representation of reality is an idealised form" "In a scientific explanation" a model is the representation of reality". As Chorley and Hagget explained "Model is a representation of simplified structuring reality. For example globe is a model of the earth. Maps are also models as they represent the earth's surface either partially or completely". All models are in need of constant improvement as new information is obtained, it needs to be incorporated in the model to have reality. Models may be in the form of a hypothesis, primitive theory, law, structured ideas, a statistical formulae stating the relation between two variables. Even a diagram is also a model. These models are highly useful for the explanation of reality and we can also understand future changes in course of time with the understanding of models.

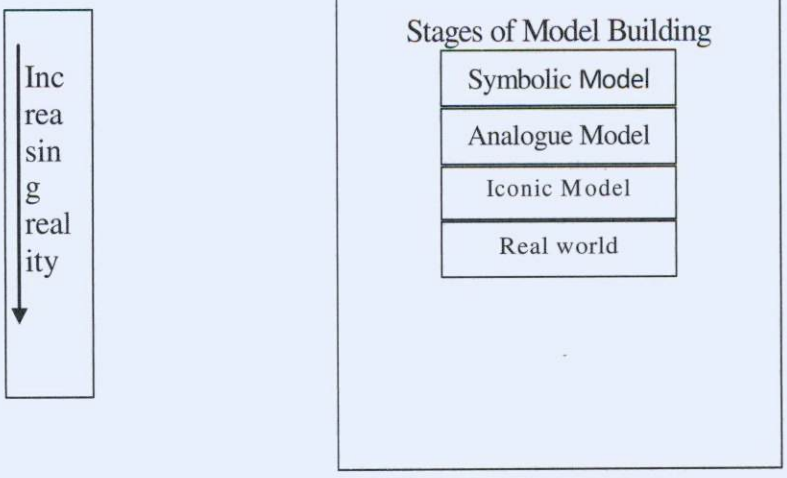
Further it may be stated that a "*Model is a skeletal representation of a theory". It implies that a theory may be represented by more than one model. However a model cannot have more than one theory. Models in reality stands at a lower level than theory. A theory is an abstract of reality where as model is a representation of theory. It is formalized expression of a theory*

15.3 STAGES AND PROCESS OF MODEL BUILDING

Model building is a long process involving several stages. These stages are interrelated. In the model building process the researcher begins to observe the real world and gradually make abstracts of facts in search of generalisation and reach the stage of model. There are three major stages of model building. These are

i Stage : In this stage the researcher observe the real world in detail. He studies the area with reference to his field of research. He will select only the features which are most relevent his research and all other are eliminated. It is the stage of iconic model. In this stage the role of researcher is significant as he is the decision maker with regard to what to concentrate? What are else to eliminate? etc.,

ii Stage : The second stage is Analogue model. In this stage one of the models is selected to represent the reality. The nature of model to be selected depends on the knowledge, experience and also interest of the researcher. For example A River Valley or the Dam to be constructed may be represented by a three dimentional model. Traffic flows consumer behaviour, landuse may be represented in the form of diagrams. Thus, a relevent model has to be selected by the researcher in accordance with the nature of research topic.



iii Stage : It is the last stage of Model building. In this stage the real world is explained with the help of the model which are the representative of the world symbolically. These are usually in the form of hypothesis. These models can be used to study other similar problems. Thus they becomes models for further studies.

15.4 TYPES OF MODELS

There are innumerable types of models. These are divided into different groups based on different criteria. The classification of models by David Harvey(1969) in his book 'Explanation in Geography' is a typical example and most relevant for geographers. He had divided all models into following three groups and further sub divided into different categories as represented below.

I Natural Analogue Models	-	a. Historical Analogue	
		b. Spatial Analogue	
II Physical System Models	-	a. Hardware Model	i Scale Model
			ii Analogue Model
		b. Mathematical Model	i Deterministic Model
			ii Stochastic Model
		c. Experimental Design Model	
III General System Models		a. Synthetic Model	
		b. Partial Model	
		c. Black Box Model	

I Natural Analogue Model :

These are the most simple form of models. Based on these models similar situations of nature can be easily explained. One can get information and inducement for evolving models of this kind from the nature itself. These are related to a large extent to different places and time. Accordingly natural Analogue Models are classified into two types namely Historical and Spatial analogue models.

a. **Historical Analogue Models :** These are related to different time or stages in relation to time. Demographic transition theory, Rostow's stages of Economic growth are typical examples of this kind of models.

b. **Spatial Analogue Models :** There represents different places but at the same time. For example 'the stages of a river' based on human life cycle, Shifting highways are compared to shifting of river courses. Thus one situation is compared to explain the other at the same time which are the Spatial Analogue Models.

II **Physical System Models :** These are the real scientific models. The real world features are represented by the same features even in the models. It means they represent the real world in the abstract form. There are three types of this category, namely Hardware models, Scale models and Analogue models.

a. **Hardware models :** As the name itself indicate there are the models prepared by solid material or concrete which represent the real world. They represent the real world features in miniature. Thus, only size differs between the model and the real world features. There are two sub types in this cotegory namely Scale and Analogue models.

The scale models are the actual representation of the real features in a smaller scale. Thus with an exception of variation of size these are similar to real features. Ex : River models, Dam Model, Maps, Globe etc. On the other hand analogue models are real representation of the world features. However these are prepared by different materials and also much smaller to the real features. For example a building may be represented by thermocoal, or transport criculation is represented by electric circuit. Similary even ocean currents may be represented by electric circuits etc.

b. **Mathematical Models :** The quantitative revolution has enabled geographers to evolve this kind of models, to represent the real features and conditions effectively. These are symbolic representation and usually in the form of formula. There are also known as 'symbolic models'. There are two types of Mathematical Models.

i Deterministic Models in which the known condition and results are represented. Meterological forecasting formulas are of this kind, vonthunen's formula of land rent R=Y(m-c) Ytd, is also an example of deterministic model.

ii Stochastic Models : These are based on the probability and the exact results are not known. These models are widely used in the spatial diffeesion studies.

iii Experimental Models : These are similar to labs. These are used in the irrigation, power,building projects. It involves preparation of a miniature model for experiment.

III **General System Models :** These are the new types of models. In these models the earth's surface is treated as an assemblage of intersecting parts. There are three types of models in this category.

i. **Synthetic System Model :** In these models synthetic systems are built artificially and these are similar to experimental design models.

ii. **Partial System Model** : These are the models in which complete knowledge regarding its working system is partially known. These represents the reality to a large extent.

iii. **Black Box System** : In this category of models the internal structure and its working conditon is not known completely

15.5 BEHAVIOURAL SCIENCE

The term 'Behavioural Science' was coined by John Dewey in 1949 and it was popularised by Ford Foundation. 'Behavioural Science study centre' was established by Ford Foundation in USA during 1950. The main objective of the centre was study of behavioural sciences like political science, Anthropology, Sociology, Psychology and Human geography.

Shift in the Social Sciences related to Human Geography :

Beginning of behavioural approach in geography owes much to its changing relationship with the social sciences. It is human geography in particular which had moved with different social sciences in its different stages of development. In the beginning it was closely related to history and anthropology. As such environmental determinism and possibilism schools were well established. In the second phase human geography had close relation with economics and sociology. The locational analysis and quantitative techniques were devoloped. Many theories and laws were advocated. The concept of *'Economic Man'*, profit maximisation strategy were adopted to the explanation of man-Environment relationship. In the modern times in addition to sociology human geography has carved out a close relation with psychology and geography had borrowed many concepts like 'Cognition' from it. The behavioural approach was also adopted from phychology for effective explanation of the relation between man and environment. Thus human geography has become one of the behavioural sciences.

15.6 DEVELOPMENT OF BEHAVIOURAL TRADITION

Behavioural tradition is concerned with the behavioural study of man in relation to his variable environment. In this approach the geographer consider man respondig to the influences of environment as he perceive it. Man is viewed as motivated social being. His decisions and actions are directed by his cognition of the spatial environment. Behavioural approach is a recent concept and its beginning can be traced up to Immannel Kant. This approach was taken up by Gilbert white in the late 1960's. He had investigated a series of human reponses

to natural Hazards. W.K.Kirk, a British geographer had presented one of the first behavioural model and explained that people act according to the way they perceive their environment and the environment as perceived might markedly different objective reality. Later Julien Wolpert has introduced behavioral approach to many young geographers through the study of actual and potential labour productivity on farms in 1964.

15.7 ENVIRONMENT AND BEHAVIOUR

The word environment includes everything ground an organism, or a community where it inhabits. All these are not going to influence on the behaviour of man; only a part of it motivate the people to behave in a particular manner. Sonnenfield has divided the environment into following four divisions which influence man differently. These are

i Geographers Environment

ii Operational Environment

iii Perceptional Environment

iv Behavioural Environment

i Geographers Environment : It includes everything of an area where a person, an organism or a community lives. It includes all other kinds of environments explained below

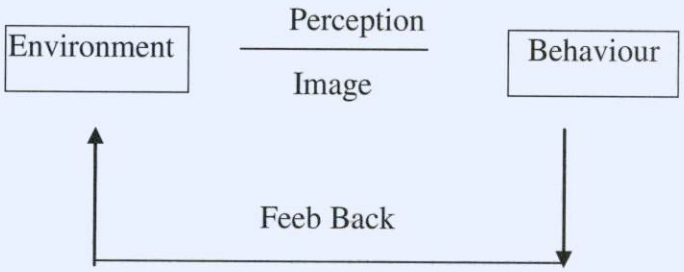
ii Operational Environment : It is within geographical environment. It influences on man in one or the other way, whether or not man is concious of it. Operational Environment differs from one individual or community to other. For example the operational environment differs between a Historian, Botonist, Zoologist and an Economist as they explain only a part of it what they perceive.

iii Perceptional Environment : The perceptional environment is the portion of the operational environment of which man is aware. The perceptional environment is the expternal world as culturally conceived.

iv Behavioural Environment : It is the environment for which man is concious of it. It is this environment which directs man to behave in a particular manner. Man acts and interacts closely with the behavioural environment. Man adopts to this enviroment perceiving its characteristics. Behavioural approach is concerned with the study of the influences of this environment on man which is reflected in wearing of cloth, sunglass, food preferences etc.

15.8 BASIC CONCEPTS

Behaviour of an individual largely depends on how he perceive the environment. Thus Environmental perception as and 'Mental Maps' are the basic concepts of Behavioural approach. Environmental perception refers to total perception an individual has about his surroundings, which create a map in his mind called 'Mental Maps': Even the decision making process depends as perception and mental map. As each ones perception of the environment differs, mental maps and their influence on the behaviour of the persons also differ. This relation can be presented as below.



15.9 SALIENT FEATURES OF BEHAVIOURAL GEOGRAPHY

- The behavioural geographers argued that the perception of environment (image) differs markedly from one person to another, from true nature of the real world. It is because of this, even in the same place, living in the same environment each individuals behaviour remains different.
- Behavioural geographers gave more emphasis and importance to individual behaviour than groups and society.
- Behavioural geography is of multi disciplinary nature. So Geographers make use of ideas, paradigms and theories devoloped by Psychologists, Sociologists, Ethnologists, Anthropologists and so as. The behavioural geography is lackiging of theories and models of its own.

15.10 APPLICATION OF BEHAVIOURAL APPROACHES

Many branches of geography have adopted behavioural approach. Peter Gould in his article "Man-against environment - A Game theoretic frame work" 1963 is one of the classical

study of human behaviour in the uncertain environment which produces dry and wet conditions unpredictably. He studied the relationality of the farmer's behavior is allocationg his land for different crops in relation to environmental uncertainties. Human behaviour due to of natural Hazards like floods has been studied with the application of Behaviourlism. W.K.Kirk, J.K.Wright have concentrated on the natural Hazards. Peter Gould introduced the concept of Mental Map and published the book Mental maps (1976) with Rodney White. Wolpert has studied the behaviour with respect to migrations. Allan Pred has devoloped behaviour matrices which is highly useful in the study of Urban Geography and Human migration decisions. Human decision making is largely related to the influence of perceived environment. As such behavioural tradition was used by Hagerstrand in the study of diffusion process and D.M.Smith with regard to industrial location. Even though Behavioural approach was evolved in contrast to quatitative revolution, many statistical tools were also effectively used in the study of human behaviour in different circumstances.

15.11 LIMITATIONS BEHAVIOURAL APPROACH

There are many limitations of behavioural approach of which the following are important;

1. One of the important drawback of behavioural approach is that most of the data related to the study of animals were generated in the laboratories and the laws based on this data were applied to understand human behaviour. Man is rational and his behaviour is different from other animals. More over human behaviour is also influenced and directed by the socio-cultural environment. As such behavioural approach has many limitations in the study of human behaviour.
2. There is a wide gap between the theory and practice in behavioural geography. Geographer in this approach is not a participitant but only an observer.
3. Most of the human individual decisions are influenced by the collective decisions of the community or the society. So even if we collect information from an individual, they are not of his own but influenced by his society. As such informations are not realiable.
4. Behavioural approach is lacking of its own theory and Laws, rather it is largely relied on borrowed concepts and theories.
5. Behaviouralism was evolved against quantitative revolution, but application of various quantitative techniques is essential even for the study of human behaviour.

15.12 LET US SUM UP

Behaviouralism was introduced into geography under the influences of psychology. It was developed as an opposite trend to quantitative revolution. The limitations of quantitative techniques for the explanation of Man-Environment relationship has favored the development of behavioral approach. This tradition is concerned with the behavior of man in relation to the environment one perceived. Gilbert White, W.K.Kirk, Peter Gould, Julien Wolpert have contributed for the development of behaviouralism in geography. Though it has many limitations, behaviourlism has remained as important concept and approach in the study of Human Geography.

There are various types of models evolved and used by geographers in relation to variable and diversified situations. These have been developed to represent the complex situations in simple manner. After quantitative revolution, model building has become a common feature and in every branch of geography we can see several models of different kind. These represents the reality in an abstract form and they are evolved with logical conclusions. There are several type of models which Harvey divided into three major groups and further divided into sub groups.

15.13 KEY WORDS

Models, Symbolic Model, Analogue models iconic model David Harvey, Historical Model, Spatial Analogue model, Scale model, Mathe matical model. Deterministic and stochastic model, experimental design model general system model.

Behavioural approach, profit maximisation, perception of environment, Mental map, Behavioural science, Behavioural environment, cognition of environment, Game theory.

15.14 QUESTIONS FOR SELF STUDY

1. Give an account of the salient features of Behavioural approch in geography.
2. Explain the concepts of perception of Environment, Mental map and Human behaviour.
3. Write about the significance and application of Behavioural tradition in geography.
4. What is behavioural approach? Explain its applications and limitations in geography.

1. Define model and explain their types.
2. Model building is a trend evolved from the quantitative revolution-Explain.
3. Give an account of model types with examples

15.15 FURTHER READINGS

1. P.E.James and C.F.Jones : American Geography : Inventory and prospects, 1954 Syracuse.
2. M.Husain - Evolution of Geographical thought, 1999, Rawat Jaipur.
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UNIT : 16 APPLICATION OF REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

Structure

16.0 OBJECTIVES

After studying this unit, you will be able to

- Introducing the two most modern means of data acquisition and analysis.
- Explain the Remote sensing has become the powerful means of aquiring spatial data of a larger area within a short span of time.
- Introduces Application of Geographic information system in geography. GIS is a new tool based on computers for handling of spatial data.
- Identify the GIS has almost revolutionalised the art of map making, Cartography, one of our sister disciplines.

16.1 INTRODUCTION

The Geographic information system, a computer based technology is effectively used in the analysis of data and also converted the information into maps. These two tools have been used even in india since two decades for inventoring, mapping and monitoring of Earth resources and mitigation and management of natural resourses. These two are hightly significant to coer a larger area. Thus, geography which was traditionally using maps drawn hand, globe, photographs for analysis and interpretation of data has entered into a new stage of computer application for data acquiring, analysis, mapping as interpretation. This lesson introduces these two modern tools of geography.

16.2 REMOTE SENSING

Remote sensing is the art and science of acquiring information without physically coming into contact. For example among the five sensors of human body, three are- eyes, ears, nose are-powerful sensors which gets information without touching the objects. Even the popular photography is also Remote sensing. Remote sensing is generally understood to imply the acquisition of information about an object or phenomenon on the earth's surface by scientific means or devices called sensors, without there being any physical contact between the object and the sensing device.

Development : Remote sensing technique was largely evolved from the military needs. The term was coined by a geographer **Evelyn L Pruitt** around in 1960. Even before the name is given, the technology was in usage. Aerial photography was the first modern means of remote sensing. **The first aerial photography was taken by felix Tournachon who**

was nick named 'Nadar' **used a baloon to photograph a suburb of paris in 1858**. However till the recent times Remote sensing was largely confined to the visible part of the Electromagnetic spectrum which constitutes only a small part of the Electromagnetic Spectrum. The present day remote sensing makes use of entire EMR particularly microwave and IR regions are highly useful. A variety of sensons and platforms have been developed for useful remote sensing. Thus, remote sensing is a modern sensing technology to record data about the physical processes on the earth's surface from far off distance. This technology is used when direct measurement is impracticable.

16.3 TYPES OF REMOTE SENSING

Broadly, there are two major types of remote sensing namely **Aerial remote sensing** and satellite or space borne remote sensing. Aerial Remote sensing refers to photographing of the required area from an appropriate height from a camera fixed to a Aeroplane. In this case, the photograph can be taken at the appropriate time and also height to get more information of the area. Satellites on the other hand are placed at different altitudes and they get the images of the area. These are also called '**Earth observation satellites**'. Satellites used for remote sensing are generally of two types depending on their altitude. These are Geo stationary and Sun Synchronous satellites.

The geo stationary satellites are stationary with respect to the earth, looking always at a particular part of the earth. These are normally placed at an height of 35,800km directly above the earth's equator that revolves in the same velocity the earth's rotation from west to east. They appears to be stationary in the sky for an observer from the earth. As the geo stationary satellites are far away from the earth the imageries have low to medium resolution only. These are highly useful for communications. The geo stationary satellites are also called geo synchronous which provides simultaneously domestic communications and earth observation functions.

The sun synchronous satellites are placed at a lower attitude between 700-900km above the ground. As such, they get imageries of high resolution. These satellites moves from one pole to another covering a particular strip of the earth's surface thoughout the earth in its every movement. Thus, a single satellite can cover the entire surface of the earth. The satellite had a constant velocity, regular scanning, and good resolution along the satellite ground track.

16.4 ELEMENTS OF REMOTE SENSING

Remote sensing is a system involving several components to aquire data of the earth's surface. Data acquiring process involves the following

- A source of light- It is the most important requirement for remote sensing. The light strikes the features of the earth's surface and reflected back in different wave length which is captured by sensors.
- Propogation of energy through the atmosphere- The energy while passing through the atmosphere come in contact with and interact with the atmosphere it passes through.
- Interaction of radiation with the target : Once the energy passing through the atmosphere reach the target on the earth's surface, it interact with it depending on the properties of the target as well as the radiation.
- Sensors : The name sensor refers to the instruments which absorbs the energy emitted or reflected by the target. Powerful sensors are fitted with the platforms of both air borne and space borne vehicles with high resolution information. Aquiring of information by the sensors is called **'Signature'**.
- Recording : The information aquired by the sensors either in pictorial or digital form is recorded.
- Transmission of data : The data aquired and recorded in the process of remote sensing is transmitted to the ground stations in the electronic form which is connected into image. These images are further analysed, data is aquired and converted into pictures, graphs, maps etc.

16.5 APPLICATION

Geography being the study of the earth's surface has great advantage of Remote sensing. The modern technology has given a new tool for aquiring and analysis of Spatio-temporal data and interpret to give a new demension to the spatial studies. While making use of Remote sensing data the problem of study should be cleanly defined. So exact data can be aquired for analysis. Some times for better analysis 'Multi Stage' data is also collected from multiple altitudes and also multi spectral data is also obtained simnltaneusly Remote sensing affords us the capability to literally see the invisible. It also transcends disciplinary boundaries. At present Remote sensing is;

- Used for environmental analyses and monitoring.
- Military surveillance
- It is highly use to study of landuse, land cover, forests and geology.
- Water resources, floods- droughts etc.
- Agriculture - Cropping pattern, yield estimations, crop condition.
- Study of soils
- Exploration of minerals

16.6 MEANING GEOGRAPHICAL INFORMATION SYSTEM

Geographical information system is a "Computer based system of collection, storage, retrieval, analysis and display of spatial information". Rhind proposes that GIS is a computer system that can hold and use data describing the places on the earth's surface. Burrough has given a more meaningful definition. He defines GIS as "a set of tools for collection, storing, retrieving at will, transforming and displaying of spatial data from the rural world for a particular set of purposes. U S Department of environment has described GIS as "a system for capturing, storing, checking integrating, manipulating, analysing and displaying data which are spatially referenced to the earth.

These definitions reveals that GIS has mainly three parts namely :

- A computer systems of hard wares, necessary softwares and appropriate procedures.
- It uses spatially referenced data
- If carries out various management and analysis tasks based on the data including their input and output. Thus GIS is able to provide
  1. Quick and easy access to large volume of data,
  2. has the ability to
- Select details by area or theme
- Link and merge one set of data to with anothers
- Analyse spatial characteristics of data
- Search for particular characteristics or features in an area
- Update data quickly and cheaply, and
- Model data and assess alternatives

3. Output Capabilities such as maps, tools, graphs to meet the requirements. Thus GIS is a combination of several branches of sciences such as Geography, Cartography, computer science, electronics, Geology, Statistics, mathematics etc. Many GIS softwares have been developed now to analyse different kinds of spatial data for different purposes.

GIS is a well established science at present. Use of GIS was first introduced in 1960's by few handful of researchers. Quantitative revolution has brought a sea change in the study of geography as most sophisticated quantitative techniques were used in geographical studies and ultimately this new trend was stronlgy opposed by many geographers. Several new approaches like behavioural, humanistic were also brought into geographical studies against quantitative approaches. Gradually use of quantitative techniques were confined to a limited problems and it was a setback for this revolution. The people who were expertised in quantitative techniques were gradually learnt computers and developed tools to handle spatial information. **Thus, GIS in real sense is an extension of quantitative revolution.**

Canada is a pioneer in the development of GIS. Its evolution was started in this country in 1963 and had spread to several countries. US census Bureau, US Geological Survey, Harvard laboratory for computer graphics, Environment Systems Research Institute(ESRI), in USA Canadian geographical information systems in Canada, Natural experimental research centre in UK were involved in the early history of GIS development. The census data files were produced in USA. Harvard Graduate School produced a grid based mapping programme called SYMAP in 1966. ESRI emerged as the leading vendor of GIS softwares. It released Arc/info software in 1981 and Arc view in 1992. Later many new softwares such as Grass by Baylor University, Idrisi by clark lab, Map info by Map info corporation, Geomatica by PCI geomatics were released. Even a new GIS software was also released by ISRO of India recently. Along with GIS softwares many books and papers in many journals were also published which have heralded the diffusion of GIS studies and Applications.

16.7 COMPONENTS

Like any other information technology, GIS requires the following components to work;

- Computer System : Includes computer and the operating system to run. The common choices are Pc's which uses windows operating system or work stations that use the UNIX of Linux operating system. Additional equipment may include monitors, digitizers and scanners for spatial data input.

- GIS Software.
- People like proffessionals and Users.
- Data to produce information. The types of spatial data are Rastar data and Vector data.
- Infrastructure: It refers to physical, organisational, administration and cultural environments that support GIS operations.

16.8 APPLICATIONS

GIS is a tool used widely for the management of resources from the beginning. It includes land use planning, natural hazard, assessment, wild life habital analysis, riparian zone monitoring etc. Even the maps based on census data is analysed with GIS tools. Health resources management is carried with this technology, It is widely used in mapping of crime records and analysis of their spatial patterns by location and time. Management of land records and insurance for flood and other natural hazards are assessed and analysed. Thus, the entire wrapping and spatial analysis have undergone drastic changes with the application GIS Technology.

16.9 LET US SUM UP

Remote sensing has become a modern tool for geographers for aquiring and study of spatial features. Both aerial photography and sattlite imageries are the important sources of data of the earth's surface. The remote sensing data is put into computers and analysed. Information of large areas which are hither to unavailable are now within the reach of geographers. So already a new trend of geographical studies with remote sensing applications have been started. Thus Remote sensing has set a new trend for Geographical studies.

16.10 KEYWORDS

Remote sensing, Aerial and satellite remote sensing, Earth's observation, Geo stationary and sun syn chronous satellites, Sensors, Signature, Platform. GIS, Spatial data, remote sensing, Aerial photography, G.P.S spatially referenced data, GIS softwares

16.11 QUESTIONS FOR SELF STUDY

1. What is remote sensing? Explain its significance in Geographical studies?
2. Explain different types of remote sensing.
3. Give an account of the Application of Remote sensing.
4. Give an account of GIS Applications.
5. What is GIS? Explain its development.

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ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

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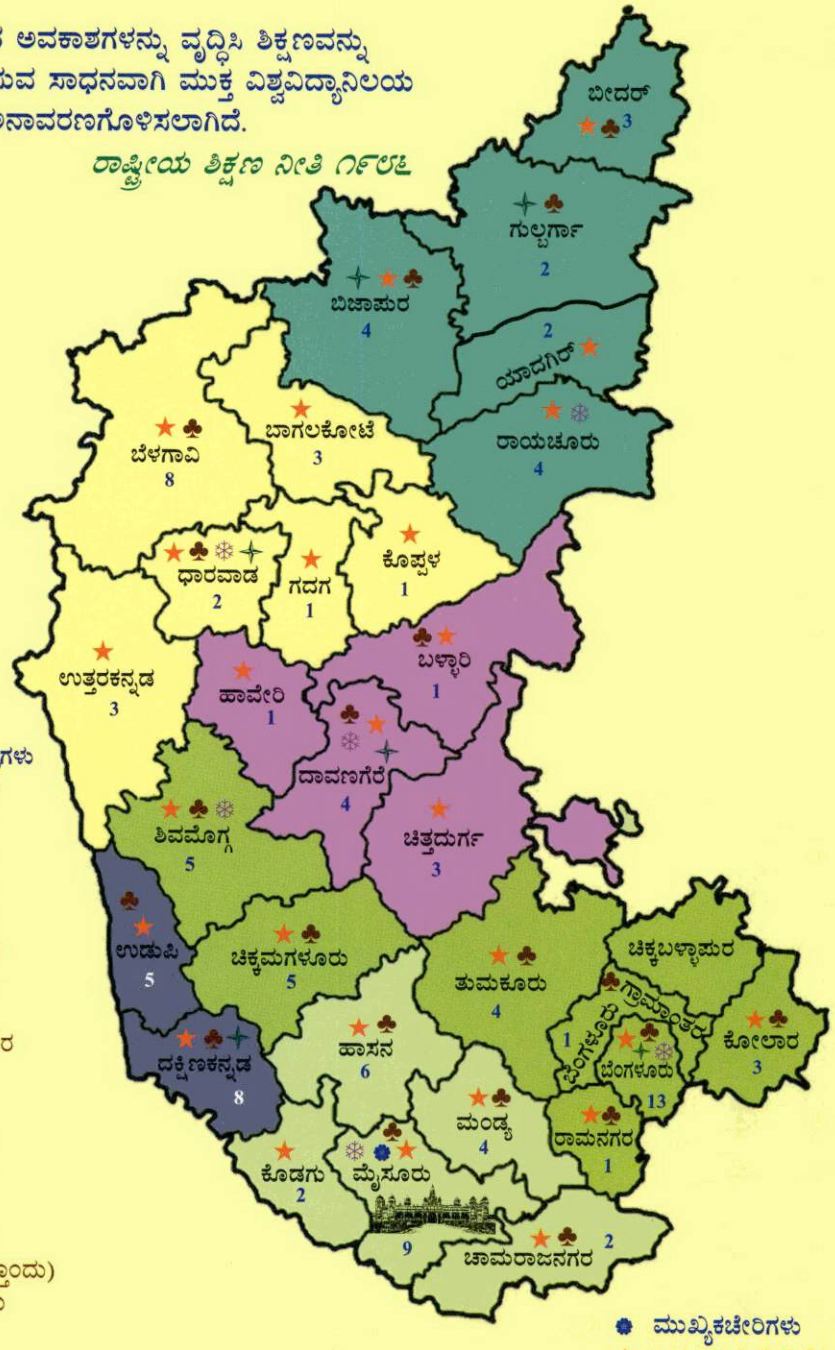

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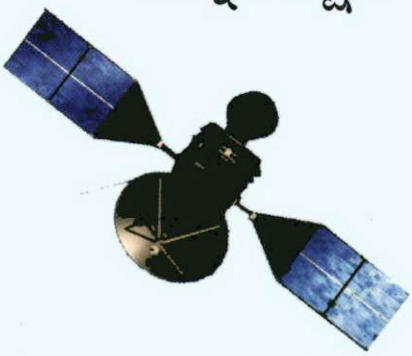

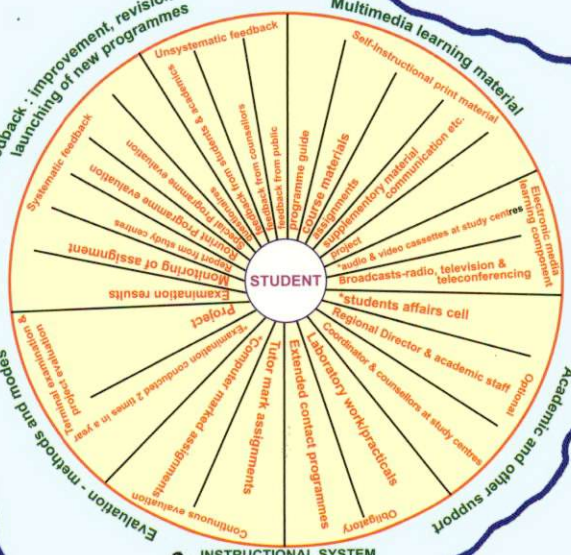

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