

World Transportation Patterns

"Transportation is a measure of the relations between areas and is, therefore, an essential aspect of geography" (Ullman, 1954: 311). The economic relations between areas is reflected in the character of transportation facilities and in the flow of traffic. Wagner (1960: 129) has stated, "the routes along which men, materials, and messages move bind a society together. They make a reticule on which are strung the sites of work and rest; they are the paths along which flow the myriad streams of raw and half-made goods in process of production; they form the links between each local group of human and the thoughts and presence of its fellows". In the reconstruction of a region or a nation, transport systems invariably play a vital role. The growth and development of transportation provides a medium, contributing to the progress of agriculture, industry, commerce, administration, defence, education, health or any other community activity. In fact, transportation pattern is a reflection of regional and/or national development.

Many factors are involved in the development of a transport system. The present-day transport system of a country or a region cannot be explained by one factor alone, but an outcome of several interrelated factors. White and Senior (1983), in their book entitled, *Transport Geography* considered five basic factors, which influences the growth and development of transport system and the ways in which changes take place. These are:

- (i) *The Historical Factor*: This involves the location and patterns of systems, technological development, institutional development and settlement, and land-use patterns.
- (ii) *The Technological Factor*: The technological characteristics of each major transport mode are considered together with a discussion of the effects of technological advances.
- (iii) *The Physical Factor*: This includes physiographic controls upon route selection, and geological and climatic influences.
- (iv) *The Economic Factor*: The structure and nature of transport costs are examined, together with service quality and methods of pricing and charging.
- (v) *Political and Social Factors*: These include political motives for transport facilities; government involvement in capital, monopolies competition, safety, working conditions and coordination between modes, transport as an employer and social consequences of transport developments.

Geographical study of transport now has become technical, which deals with network analysis, commodity flow, transport costs, system analysis, planning, etc. In this chapter we are not dealing with technicalities and special aspects of transportation, but discuss only the general pattern of world transport.

Transport systems, which are operated at the global scale, are the expansion of the need for links between both individual nations and trading blocs, and have complex networks. For the purpose of present analysis, i.e., world transportation patterns, the transportation systems can be classified into the following three broad categories:

1. Land transportation
2. Water transportation
3. Air transportation

LAND TRANSPORTATION

The earliest form of land transport was Man himself. They used narrow paths, beaten out and maintained only by use and rarely were specially constructed except at bridges. In some parts of the world human portage is still prevalent today, e.g., in thickly forested regions or rugged mountains where roads are difficult to build and in sparsely populated regions where the cost of construction is not warranted by the amount of traffic to be expected.

In many countries man himself is the only means of transport. In Central Africa, China and India, men are still employed to carry loads for short distances. The relief and climate of Africa from the Sudan to the Zambesi are such that it very difficult to construct roads and railways. Hired porters carry ivory, rubber, palm nuts and other products of Savannas. The slopes of the mountains may be too steep for animals, as in some parts of the Himalayas and Tibet, or harmful insects may prevent the use of transport animals as in Central Africa, the middle Amazon basin, etc. In such regions, heavy loads are moved by human labour.

After animals had been domesticated a wide range of *beasts of burden* was employed, including dogs, horses and donkeys, cattle, yaks, camels and elephants among others. Man employs many animals in his service and also employs them as his beasts of burden. The horse is the common transporting animal in the temperate lands. In the hot deserts of the Old World, camels carry heavy loads and can travel more than thirty miles a day. Elephants are employed in India and Burma and parts of Africa to carry loads and they rendered valuable service in the teak forests of tropical Asia. Yak is the beast of burden in the mountainous regions of Northern India and Tibet, and the mule is serviceable in the mountain areas near the Mediterranean Sea and Mexico. In the north-west of Canada and in Siberia, sledges are drawn by hardy dogs over the frozen snow. The reindeer has been introduced in Alaska and parts of Canada.

The invention of the *wheel* was another major step forward in the development of transport. The use of carts and wagons, drawn by animals, allowed far larger loads to be carried, or enabled several people to ride in a carriage compared with one on horseback. But these carriages required some medium in the form of cart tracks or roads. Of all land routes, the *road* is most ancient as well as the most universal. Another important means of land transport is the *railway*. Another modern development in transport on land, though as yet of more limited use than

the road and railway, is the use of pipeline for carrying liquid commodities of many kinds, e.g., water, milk, mineral oil and gas. But in general the modern land transport means road and railways, which needs detailed analysis.

Roads

Roads and pathways have been stamped out by men since the earliest time. They are the most universal as well as varied form of transport. Roads of one kind or another, ranging from forest paths to the latest highways have several important features. First, wherever a demand exists for a route from place to place a path or road is soon established. Second, roads can be used by a very wide range of transport agents.

The vast importance of contemporary road transport is very much a reflection of this unrivalled convenience to the user, especially in the conveyance of persons. No other form of transport is able to provide such a comprehensive door-to-door or origin-to-destination service, nor does any other mode have such an extensive route network.

Road transport is particularly suitable for short and medium distance travel on account of its convenience. For personal travel, the car is widely used for both work and leisure trips. In case of the former, public transport is usually available as an alternative but for non-work trips the advantage of the private car is even more pronounced, since, flexibility as well as convenience is an additional factor inherent in its use. Over the past 60 years, road transport has become increasingly important for long distance travel due to the construction of motorways (known as 'autoroute' in France, 'autobahn' in Germany, autostrade in Italy and National Highway in India), specially constructed arterial, dual carriageway roads, as well as the straightening, widening, and cambering of the already existing highways. Consequently, roads are now being used for the movement of goods over longer distances: this can be attributed to improvements in vehicle technology and, as in personal travel, to the development of better roads and, more especially, motorways. This trend is in great contrast to the early function of road goods transport which was seen to act as a feeder for rail services. A big advantage of road transport is that it overcomes the transfer problems of rail movement and this certainly appeals to some own account operators. The post-war period has also seen the rationalisation of the public carrier branch of the industry and this has done much to improve the industry's image in terms of responsibility and respectability. Perhaps the major disadvantage of road transport is the limited carrying capacity of the individual vehicles. Just as coaches and buses have gradually increased their carrying capacity, so also road transport goods vehicles have developed greatly increased carrying capacities, e.g., articulated lorries, special bulk carriers, trailers.

Roads are the most common means of surface transport, but its importance is mostly restricted to national limits. The neighbouring countries may allow or not allow international movement. It depends upon their political and strategic interest. But this much is clear that all the countries of the world are having road transport and more a developed country, more efficient and developed is its road transport connectivity. Even developing countries are having good road network.

All the European countries are having well-developed system of road highways and the road mesh is very close in the more populous and industrialised areas. The

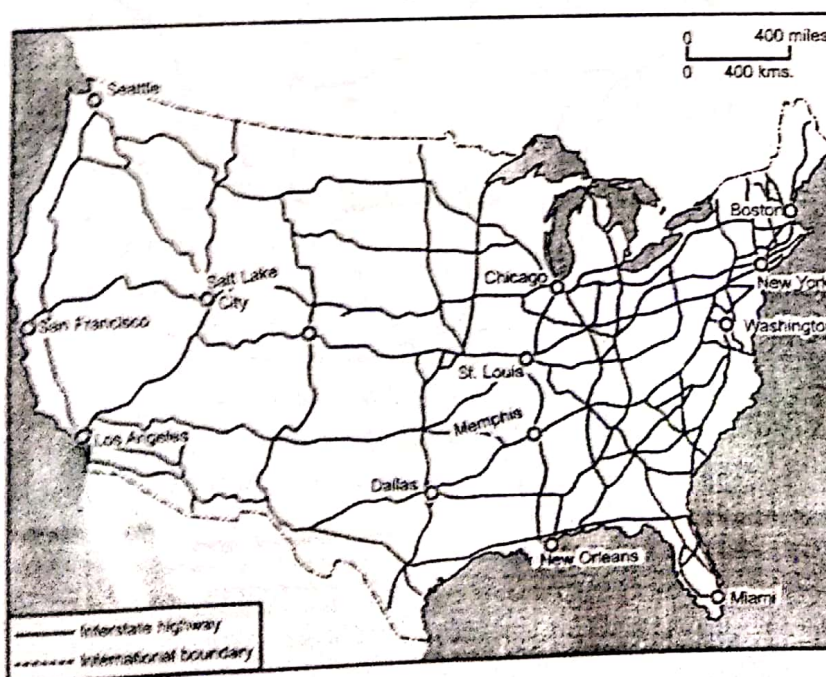
countries of North-West Europe like UK, Germany, France, Netherlands, Belgium, etc., and also Spain and Italy have dense road network. Many of the main highways follow age-old routes; in England and France and in many parts of southern Europe, roads are often patterned upon the original Roman network. The French road network is the longest in the Europe, followed by Germany, Belgium, Netherlands, Sweden, Italy and Spain. Eastern Europe is also having good road connectivity, both within the country and with other adjoining countries. The 10,700 km of autobahn in Germany is the largest network in Europe.

The former USSR, with its vast area, has developed road transport system; but in comparison with European countries and USA, its road connectivity is limited. This also is because of the fact that a vast sizeable area is under the cover of ice, and in many other areas of central and eastern part, the topographical conditions are not suitable. In spite of all these conditions, the length of road network has increased more than tenfold since the revolution. During the last twenty-five years, the progress in road transport development is very fast and all the countries of former USSR are developing their internal road transport system.

In North America, the USA has about 34 per cent and Canada around 5 per cent of the roads in the world. USA is now having a well-developed and highly dense road network in the world. Its total length of roads is about 7 million km. Another characteristic feature of the United States is that there are several trans-continental highways. The Trans-Canada Highway links St. John's, Newfoundland, with Victoria on Vancouver Island in British Columbia, a distance of 7,821 km. The interstate highway network in the USA has been depicted in Figure 13.1. The interstate highway network was the largest civil engineering programme in American history.

Most of the roads in Canada lie in the southern parts of the country. Northern Canadian region is still having limited roads due to adverse geographical conditions.

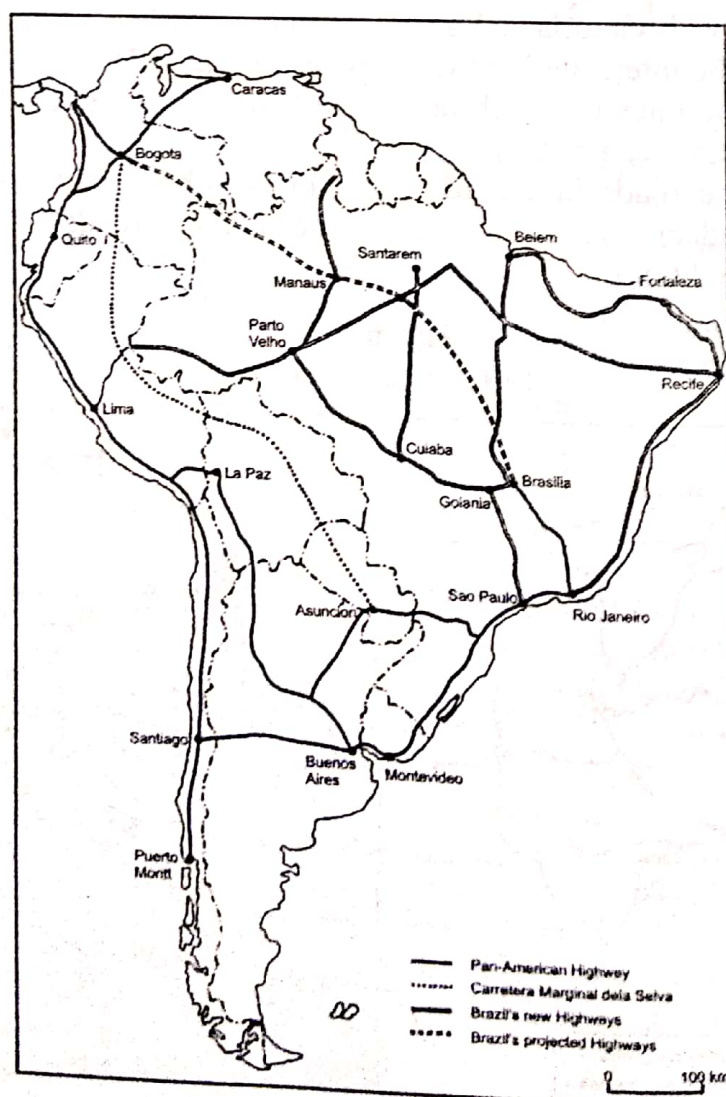
Figure 13.1
Interstate highways of USA



In Latin American countries, road development is limited and varied. Argentina and Uruguay have reasonably adequate highway networks, but extensive areas are ill-served with roads. Brazil had some 1.2 million km of road, but apart from the network in the south-east, which accounts for nearly 75 per cent of the total road length, most of the areas are still not having road connectivity. The Pan-American Highway is a unique feature of the road transport in Latin America. These highways have been designed to link all the countries of North and Latin America. The Pan-American Highway linking Fairbanks, Alaska with Puerto Mont, Chili and Buenos Aires is a notable highway. Another international highway is the Garretera Marginal Bolivariana de la selva (commonly known as 'La Marginal') running along eastern foothills of the Andes through Columbia, Peru and Bolivia (Figure 13.2).

In Asia, countries like China, Japan and India have a developed highway system and a dense road network. In other countries of South-East Asia also, road transport is the main source of transportation. While in West Asia, desertic conditions have restricted the road development, but now gradually these countries are also developing their highway system. In China when Communists came into power they began a strenuous programme of highway construction which

Figure 13.2
Important highways of South America



continues to the present and it is estimated that there are now over 5 lakh km of motorable roads in the country. In Japan, although railways are more important, but the country has also developed a good road network. In Japan, in addition to the A grade expressways that have been constructed, there is a national plan for new arterial highways.

In India, roads are the principal means of transportation. Indian road network is one of the largest in the world. The history of roads in India is as old as its civilisation. In early stages of Indian history, Ashoka and Chandragupta made efforts to construct roads. But, the real progress was made during the Mughal period. A number of roads were laid during the Sultanate and Mughal period. Most modern trunk routes follow the Mughal routes. One such road was constructed by Sher Shah Suri, which connects Peshawar to Kolkata. It was named Grand Trunk (GT) Road and now joins Amritsar with Kolkata. During the British period, a network of roads had not only been planned but were also developed. The first serious attempt to develop roads was made in 1943, when Nagpur Plan was drawn. This plan envisaged increasing of the kilometrage of major roads to 1,96,800 km and of other roads to 3,32,800 km by 1953. In fact, after independence, the Indian government along with the state governments has given this much attention and the process of development still continues. In India, National Highways are the prominent interstate roads constructed and maintained by the central government, while state governments maintained state highways, district and village roads. The length of National Highways increased from 19,811 km in 1951 to 70,550 km in 2010. Nearly 40 per cent of road traffic in India is carried on these highways. A comprehensive plan of National Highway development in the form of Super National Highways, Mega Highways, Express Highways, North-South Corridor and Golden Quadrilateral is also ongoing presently. On the whole, India is developing its road network on priority basis but still has a long way to go.

Africa is a vast continent, but because of its physical conditions and economic backwardness, road development is still limited in many of the African countries. The total road length of Africa is estimated around 2 million km, of which perhaps 20 per cent are paved. Though in the past two decades there have been very substantial improvements, the overall picture is one of complete inadequacy. The need for new and improved roads continues to be a major requirement for African economic development.

The total length of roads in Australia suitable for general traffic is about 8.6 lakh km. Most of the road development in Australia has occurred in south-eastern and south-western part, that too, along the coast. The road development was first focused to connect port towns with its hinterland. All the urban centres are well-connected by roads. Special mention should be made of what are termed the "beef roads" of northern Australia, which are essential to the cattle industry. New Zealand, although, having a hilly topography but its plain and coastal regions are well-connected by road transport.

Railways

Railways are the most important means of inland transport. Railway was, in a real sense, a product of the industrial revolution and afterwards became a

predominant mode of inland transport. Railways solved two important needs: (i) the economic carriage by land of (a) materials in bulk, (b) bulky commodities, and (ii) the relatively rapid movement of large number of people as well as goods. The rails always revolve around its fixed track. This provides guidance for the wheels and also enables very heavy loads to be carried.

The opening of public traffic on September 27, 1825 of the Stockton and Darlington Railway is among the great events of history. The date marks the inauguration of the railway era in which we now live. Railways have the following obligations to meet:

- (i) the cost of capital expenditure on tracks,
- (ii) the cost of maintenance of tracks,
- (iii) the cost of rolling stock, and
- (iv) the cost of additional restrictions for the safety and convenience of the public.

Railways are providing both long distance as well as short distance mode of carrier. There are national and international railways, while some intercontinental railways are also in function. Rail's main contemporary function, specially in developed countries, lies as a provider of inter-urban travel. Railways are able to achieve higher speeds and also easier access into the heart of cities. New technology has further helped railways to perform their function more effectively. Advance has also been made in improving the design of carriage units which, along with track changes, have promoted a better ride for passengers. Consequently, train speeds of up to 200 kph are now being achieved by high-speed trains. Railways are providing goods service in all countries of the world. The main advantage of rail is for movement of heavy, bulky goods and of coal and mineral ore in particular.

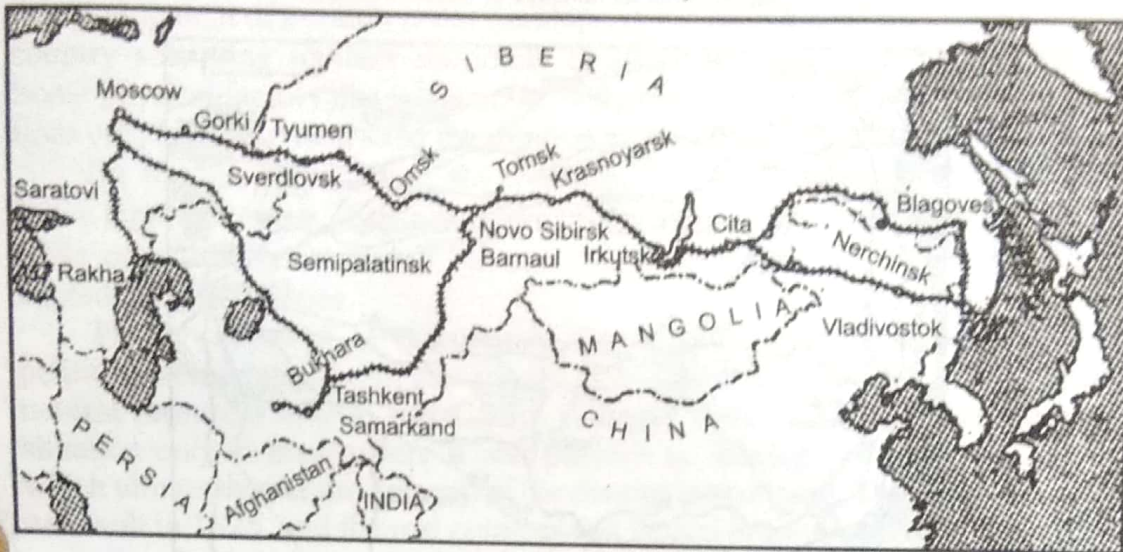
The two categories of railway, i.e., transcontinental and national are important.

Transcontinental Railways

Transcontinental railways are those which are running across the continent. The railways running from the Atlantic to the Pacific Coast in North America are described as "Transcontinental Railways". Such also are the Canadian National Railway, and the Canadian Pacific Railway. But, in common use, all those railways which reach the Pacific Coast from the Mississippi or from Chicago are described as 'transcontinental', whether there is a through coast-to-coast service or not. Other such railways are the Cape-to-Cairo Railway in Africa and the Trans-Siberian Railway in Asia. The Paris-Berlin-Moscow route, Paris-Milan-Brindisi route; and the Berlin-Vienna-Istanbul route may be called transcontinental railway systems in Europe.

The Trans-Siberian Railway connects Russia with the Far East. It runs from Moscow to Vladivostok on the Pacific, the distance being 9,500 km. Although this line was constructed for strategic purposes, it now carries a large volume of traffic. The settlement of central and eastern Siberia is largely due to this railway system. It has additional value as an alternative route between Europe and Asia on the Pacific for passengers and mails. The line was constructed by the government for the purpose of facilitating the work of administration in Asiatic Russia. It is a single-track system. From Moscow the line goes to Omsk after crossing the Urals

Figure 13.3
Trans-Siberian Railway



and traversing the agricultural lands of northern Steppe provinces where wheat-fields are prominent. From Omsk the line goes directly eastward, crosses the Obi and the Yenisei and soon reaches Irkutsk and Lake Baikal. The line then goes from Lake Baikal to the Amur valley and passes through Manchuria and finally reaches Vladivostok. In Manchuria, a southern branch has been opened at Harbin which connects Port Arthur via Mukden. Mukden is linked up with Peiping by rail.

The Trans-Caspian Railway connects central Asia with European Russia. The line runs from Krasnovodsk, on the Caspian Sea, to the heart of the cotton-growing region of Turkestan, throwing off a branch on the Afghan frontier from Merv to Kushk. Krasnovodsk is connected with Moscow via Tashkent.

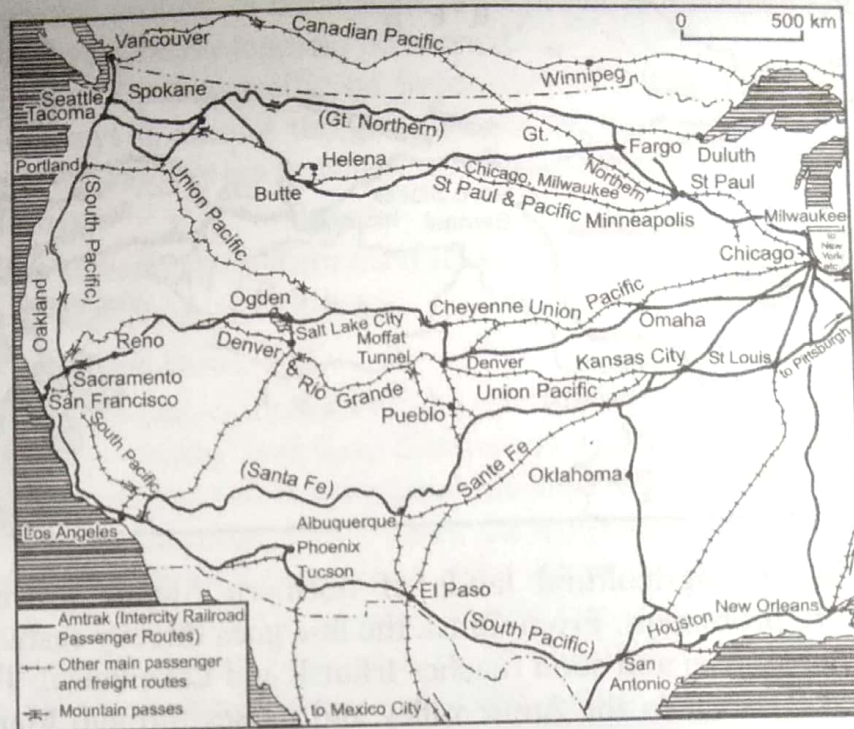
The Canadian-Pacific Railway was built during the years 1882–86: The length of the line is 4,340 km. This line connects the Atlantic coast of Canada with its Pacific coast. The line runs from Halifax and St. Johns to Montreal. From Montreal it goes to Winnipeg, the great wheat centre of Canada. The line crosses the plains from Winnipeg via Regina and reaches Medicine Hat in the Rockies. Leaving Medicine Hat, it goes through Kicking-Horse Pass, and ends in Vancouver. This railway system has played a very important part in the political and economic life of the Dominion.

The Chile-Argentina Railway or Trans-Andean Railway of South America connects Buenos Aires with Valparaiso; the distance is nearly 1,440 km. This route was opened for traffic in 1910. As there is a change of gauge both at Mendoza on the Argentinian side and at Los Andes on the Chilean, the route is useful only for the carriage of passengers and mails. Of the four transcontinental lines in South America, none is more important commercially than the Chile-Argentinian line. The interchange of products between the eastern and western zones of the Continent is small.

Union Pacific Railway

This railway passes through the central part of the USA. This railway was built in the year 1869 and is one of the longest railways of USA. It starts from Chicago

Figure 13.4
Transcontinental railways of North America



and reaches up to San Francisco located on the Pacific Coast. Its two branches: (a) Chicago to Mississippi and (b) Chicago to New York are also important.

In USA, other transcontinental railways are Great Northern Railway, Northern Pacific Railway and Southern Pacific Railway (Figure 13.4).

Cape to Cairo Railway

In Africa a transcontinental railway was proposed from Cape of Good Hope to Cairo.

There is no transcontinental railroad between North Africa and South Africa. There was a scheme before the World War to construct a railway line from Cape of Good Hope to Cairo. As Egypt was then under the influence of the British, the purpose was to have an all-British transcontinental railway in Africa. The scheme, however, did not work out. A railway line from Cape Town goes up to the border of Congo via Bulawayo and Elizabethville. From Elizabethville, the capital of Katanga, a river-cum caravan route proceeds to Lake Victoria, from where a motor road runs to the Nile gorge. From here steamers maintain regular service to Khartoum. From Khartoum a railway line goes to Wadi Haifa, thence by river-transport Shellal is approached. From Shellal a train runs to Cairo.

Perth-Adelaide Railway

In Australia a transcontinental railway runs between Perth located at south-western coast to Sydney located at south-eastern coast of Australia. The main in-between stations on this railway line are Kalgoorlie, Koolkordi, Post Agusta and it also connects Adelaide, Melbourne and Canberra with Sydney (Figure 13.5).

Orient Express Railway is one of the most important railways which connect Paris with Istanbul, the capital of Turkey.

National Railways

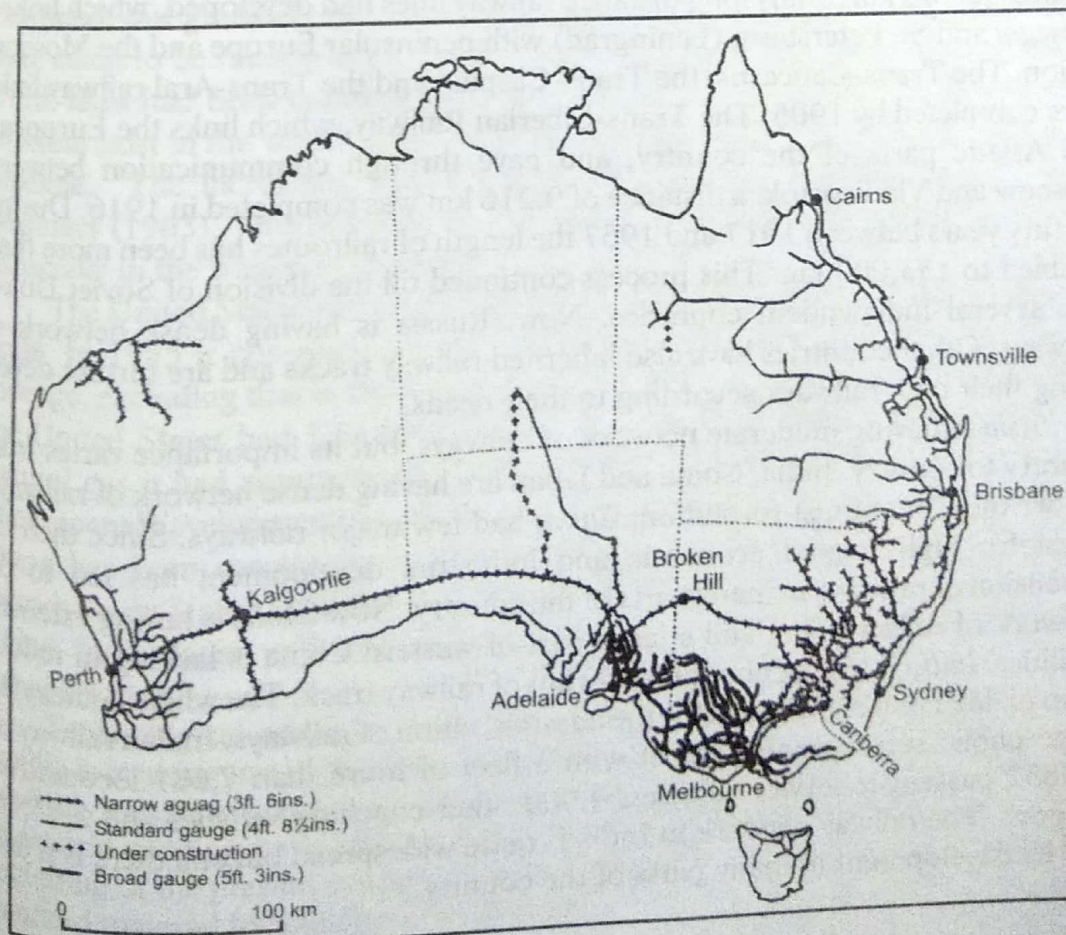
Every country of the world is having its own railway system, which is necessary for the development of a country. But development of railways varies from country to country according to their economic development and resources availability. Some physical factors like snow cover, hilly terrain, desertic and marshy conditions etc., have also restricted the expansion of railways within a country.

On the one hand, there are countries like USA, Russia, Canada, China, India, Japan, Germany, France, UK, etc., which have a dense network of railways, while other countries, mostly African, Latin American and Asian, are having limited railway facilities.

The development of railroads in the United States came not only from political considerations, but also from a keen desire to exploit the easily available natural resources and to move them cheaply. Water transportation eased the situation only in areas where it was possible to develop. Thus, it was railroad which ultimately met the demand of the country's economy. The first railway line was built in 1825, and the real construction period began in 1869. USA has now more than 3,70,000 km of railroads.

Canada has a little less than 75,000 km of railroads, the beginning of which was made first in 1835. The original purpose of railroad construction was to foster easy communication between the different scattered communities so that they might form into a political unit. The transcontinental lines were built to connect the east coast with west coast. The railroad is the most important factor of

Figure 13.5
Railways of Australia



Canada's prosperity as it helps in providing outlets in export market for the large surplus of agricultural produce. The latest development of railroad in Canada is its extension to northern sides in the interest of mining industry.

The railroad systems in *Europe* have been influenced by the large number of independent countries in a small continent, each developing the system to meet its requirements as dictated by geographical, economic and political demands. There is no uniformity in respect of gauge. The railroads are being competed by other forms of transport – notably automobiles. The high density of traffic is in the industrial areas of North-West Europe. However, the traffic is heavier in respect of passengers and not of freight, in contrast to USA, where it is heavier in freights.

Germany, because of its location and larger population has the largest traffic transportation. The low passenger traffic in France is due to low density of population. In Italy, however, large arrivals of tourists every year account for a greater volume of railway traffic even though density of population is low. More recent developments has led to the rationalisation of railway networks in many countries and the closure of many lines. There are approximately 4,40,000 km of railways, most of which are double-tracked or multiple-tracked and on standard gauge. The railways radiate from the main cities, e.g., Paris, Berlin, London, Brussels, Milan, etc. Underground railways are important in many European capitals, e.g., London, Paris, etc., and carry huge numbers of city workers.

Among the developed countries of the world former *Soviet Union* is unique in its dependence upon railways for its transport needs. Considerable railway development had taken place in Russia during Transit times, and when Communists came into power in 1917, they inherited a fairly extensive network which totalled 58,500 km. Many long distance railway lines had developed, which linked Moscow and St. Petersburg (Leningrad) with peninsular Europe and the Moscow region. The Trans-Caucasus, the Trans-Caspian and the Trans-Aral railway links were completed by 1905. The Trans-Siberian Railway, which links the European and Asiatic parts of the country, and gave through communication between Moscow and Vladivostok, a distance of 9,216 km was completed in 1916. During the fifty years between 1917 and 1967 the length of railroutes has been more than doubled to 133,000 km. This process continued till the division of Soviet Union into several independent countries. Now, Russia is having dense network of railways. Other countries have also inherited railway tracks and are further developing their own railways according to their needs.

Asia is having moderate network of railways, but its importance varies from country to country. India, China and Japan are having dense network of railways. Before the Communist revolution, *China* had few major railways. Since then the quest for high rate of economic and industrial development has led to the expansion of railways in many parts of the country. Now China is having extensive network of railways, but still a large part of western China is lacking in railway facilities. *India* is having about 65,000 km of railway track. The whole country has been divided into eight zones for the administration of railways. Indian railway is a large public sector establishment with a fleet of more than 7,681 locomotives, 39,852 passenger service vehicles, 4,900 other coaching vehicles and 2,14,760 wagons. The railway network in India is quite widespread but still there is a need for its development in many parts of the country.

Japan's railway network is only of about 30,000 km, but because of country's small area, the network is very good and effective. Japanese railways are best developed in the coastal lowlands between the major industrial cities. They are mainly electrified and noted for their speed and efficiency. The Tokyo-Osaka or 'Tokaido' Express is world famous.

Other Asian countries are also having their own railway networks. South and North Korea, Pakistan, countries of South-East Asia etc., also have railway tracks. But in West Asian countries railways are very limited.

Pipelines

Another mode of land transport is the pipelines which are used to transport certain items in liquid and gas form. A pipeline may be defined as a line or conduit of pipe of variable diameter and length, but sometimes hundreds of kilometres long, traditionally used for carrying a liquid or gas from a point of supply to a point of consumption. The use of pipes dates back to the Christian era; water supplies are known to have been piped over long distances since very early times. In China, bamboo pipes were being used in circa 5000 BC, and pipes made of clay or stone were widely used in the ancient civilisations of Egypt, Mesopotamia, Greece and Rome.

The discovery and use of petroleum ushered in a new era in pipeline use. The first crude oil pipeline, constructed of wood, was laid down in the United States in 1861 but this proved to be unsuitable, and the first successful pipeline was made of cast iron in Pennsylvania in 1865. In the early days of the oil industry, pipelines served local purposes, only transporting the crude oil to a nearby refinery or to a rail-head, but gradually the value of piping crude oil or the refined products in bulk came to be recognised and before the end of the 19th century a number of trunk lines had been constructed. Today, nearly half a million kilometres of oil pipeline exist in the world, together with a slightly smaller distance of natural gas pipeline. "The increasing use of pipelines in recent years represents," wrote Manners (1963), "one of the most notable revolutions in the history of transport, especially in the transport of energy."

The United States was the first country to use pipeline transport on a massive scale. In 1955 it possessed 88 per cent of the total world oil and gas pipeline mileage, excluding that in the Soviet Union: of nearly 2,24,000 km of oil pipeline, the United States had 1,84,000 km and of some 2,50,000 km of pipe carrying natural gas it had approximately 2,24,000 km. Since that date there have been phenomenal developments in pipeline usage, especially in other parts of the world. There has been spectacular growth of pipeline system in Western Europe, in former Soviet Union, Middle East, North Africa, Canada and Latin America. Now China, India, Japan and several other countries are using pipelines as means of transportation.

Technological advances have contributed substantially to this recent and rapidly increasing use of pipelines for transportation purposes. The production of relatively inexpensive pipes on a large scale and the development of the technique of electric welding have assisted, more especially, the use of pipelines. By the beginning of the present century, steel had replaced cast and wrought iron as the standard material for pipeline construction.

The main use of pipelines at the present time is for the transport of bulk fluids and gas but increasing attention is being paid to the possibilities of transporting other kinds of commodities by pipeline, especially since roads and railways are becoming increasingly congested, with inevitable delays in delivery, and because of labour problems and difficulties. Considerable research has already been devoted to the practical possibilities of conveying a wide range of commodities by pipeline and, in fact, a number of experimental pipelines carrying solids are in operation.

WATER TRANSPORT

Since, prehistoric times, water transport has been used for carrying both men and goods. Water transport probably developed before the use of animals because waterway formed an easy means of travel in places where dense forests on land hindered movement. The range and importance of water transport was increased when power of wind was harnessed by use of boats or some other medium. At first, boats were small and confined mainly to inland waters and sheltered coastal areas. The gradual increase in size and complexity of sailing craft allowed trade to be established. The Phoenicians, Egyptians, Greeks and Romans as well as Arabs and Indians had wide trading contacts. The use of steam has given a new dimension, greater power and speed to water transport to carry larger goods at long distances. The use of diesel and other forms of power has changed the entire scenario of the water transport and today most of the world trade is water-borne. The two greatest advantages of water transport are that it uses oceans, rivers, seas and needs no special tracks, and that it is the cheapest form of transport for large and bulky loads. Water transport can be divided into following two categories: (i) inland waterways, and (ii) ocean transport.

Inland Waterways

There are three types of inland waterways, namely, rivers, rivers which have been modified or canalised, and specially constructed canals. In earlier times much, perhaps most, of the inland carriage of commodities was by water. This was possible when vessels were small, the volume of traffic limited, and the time factor was not particularly pressing. But during the 18th century, ships began to grow in size, trade began greatly to expand, and speed of carriage came to be of greater importance. In order to overcome the limitations of many rivers and, also, to provide many inland towns with water communications, canals began to be built. In England, a pioneer in canal construction, the building of these new man-made waterways became almost a mania. Canal building on the Continent came somewhat later, although there are some examples of early canals, e.g., the Canal du Midi in southern France was constructed in 1681. In 19th century, there was some decline in inland water transport due to development of railways and road transport. But after sometime, water transport has tended to make a comeback, this is closely linked with the cheapness and capacity for bulk carriage of water transport – witness the recent and current developments of the Albert Canal, the Valley Scheme, etc. Inland waterways have both advantages and disadvantages. The chief advantages are:

- (i) there is no track to lay or maintain, although dredging may be necessary in the case of natural waterways;
- (ii) they may provide the only practicable routes, e.g., in very difficult, mountainous country or in areas of very dense tropical forest; and
- (iii) waterways, under favourable conditions, provide cheap transport for heavy, bulky, imperishable commodities such as coal, ore, timber, cement.

The principal disadvantages of inland waterways are:

- (i) rivers may involve devious journeys and may flow in the wrong direction from the point of view of trade;
- (ii) otherwise navigable rivers may be interrupted by falls or rapids while canals require locks if there are differences in level;
- (iii) river levels may change seasonally and freezing may occur in winter causing stoppages in navigation;
- (iv) canal construction involves heavy capital outlay and canals require constant maintenance and sometimes dredging, and may also require a water supply;
- (v) transport by water is slow in comparison with most other forms of overland transport and carriage by water is generally unsuitable for perishable produce; and
- (vi) waterways are less flexible than either roads or railways which can more easily adapt themselves to changing industrial location.

Although water transport is carried on to a greater or lesser degree the world over, there are only six major navigable systems of inland waterways: the rivers of Western and Central Europe, the Volga-Don system, the North American rivers, the Amazon system, the Parana-Paraguay system, and the Chinese waterways.

Inland waterways are best developed in Europe and North America; in other continents their development is moderate. A brief review of inland waterways is as follows:

Europe

In Europe, France, Germany, Belgium, Netherlands as well as Russia, have very extensive inland waterways including rivers and canals. France is having 5,600 km of navigable rivers and another 4,800 km of canals. The major French rivers, e.g., Loire, Garonne, Seine, Rhone, Meuse and Moselle have been modified and are linked by canal systems so as to travel entirely by river and canals from Mediterranean Sea to English Channel or from Rhine to Atlantic Ocean. On the other hand, Germany is having 7,040 km of inland waterways. The important inland waterways of Europe are:

The Rhine Waterway

The Rhine is the busiest navigable river of the world. On both sides of it have developed heavy industries which benefit from cheap water transport. The river is navigable by ocean-going steamers of small size. From the point of economic geography, the rivers prolong the great ocean routes into the interior of lands. Of the "flowing roads" the Rhine is one of the most remarkable. It leads from the ocean into the very heart of the Continent. The Rhine is a "coal river". The lignite of the Aachen basin and the coal of the Ruhr furnish the greater part of the river freight.

The Rhine is one of the rivers most favoured by nature for navigation. The greatest difference between the Rhine from Basle to Strasbourg, and the Rhine from below Strasbourg is the heavy gradient in the upstream stretch, which causes a very swift current. Above Strasbourg the traffic is slight owing to a rapid current, low water and a rock ledge near Istein. But below that point there is a slow current except in the gorge of the Slate Mountain (between Bingen and Bonn). The volume of water is uniform during summer. Rhine navigation is stopped during the months of winter owing to low water.

The Rhine from Basle to Strasbourg is characterised by a torrential regimen betraying its Alpine origin. The seasonal variations – summer floods and winter low water – are the more pronounced and rapid as the gradient increases from Basle to Strasbourg. A barge which carries a full cargo to Strasbourg in summer must discharge half en route in winter. The Rhine navigators invariably allow a margin of 30 cm between boat-keel and river-bed to guard against sudden fall in the waters which may be very rapid in case of drought.

The Rhine empties into a tributary sea of the North Atlantic which lies at the beginning of the largest current of world commerce. This is a privileged position as compared with most other rivers of Europe. To take advantage of this, other rivers near the Rhine have been connected to it by means of canals. The result is that there is no other river in Europe which has so many canal connections as the Rhine.

Waterways of the Germanic-Baltic Lowlands

An extensive network of waterways consisting of east-west canals joining the north-south flowing rivers crosses the northern German plain. The Mittelland Canal, also known as the Midland Canal was built in 1938, joins the three major rivers of Ems, Weser and Elbe. Kiel Canal is 96 km long, links the Elbe estuary to the Baltic Sea. The Dortmund-Ems canal runs north-south and links the Rhine with ports of Bremen and Emden.

Waterways of Southern Germany

Danube is the main river, which flows through seven countries – Germany, Austria, Czech Republic, Hungary, Yugoslavia, Romania and Bulgaria and navigable for about 2,400 km. Canals like Ludwing Canal, Rhone–Rhine Canal provide a good inland waterway.

In Belgium, total length of inland waterway is 1,535 km. Albert Canal (built in 1940) and also other canals on coastal plain serve the towns of Ghent, Bruges, Zeebrugge and Ostend. Netherlands, at the mouth of Rhine, is criss-crossed by its distributaries, and also has extensive man-made waterways.

The former Soviet Union, has developed a system of navigable waterways totalling 1,44,000 km. Most of these waterways are located in European Russia. The Baltic and White Sea Canal, the Moscow-Volga Canal and Volga-Don shipping canals are nodal. There are several rivers like Volga, Dvina, Don, Dnieper and Dneister, which are navigable in many parts. But many Russian rivers remained blocked during winter season. In spite of such defects Russian rivers are very important for domestic and foreign trade.

North America

In North America the rivers of most use for navigation are the Mississippi and Missouri and the most important canals are those of St. Lawrence, which unites

the Ontario and St. Lawrence; the Sault Sainte Marie canal, between Superior and Huron; the canal which links the Chesapeake to the Ohio; the New York canal; and the canals between North Allegheny and Erie.

The length of navigable waterways in United States is over 36,072 km. The Mississippi river system, largest of all, provides more than 8,000 kilometres of waterways with depths of 3 metres or more, including the main river trunkline from Minneapolis to the Gulf of Mexico – a distance of more than 12,880 kilometres. The Missouri, a tributary of Mississippi, is navigable for 1,216 km to Sioux city, Iowa.

On the recommendations of The Ralph M. Parsons Company, a private engineering and construction enterprise with headquarters in Los Angeles, was set up under the project to carry out technical assessment of water and power potential of North America. The project is referred to by the company as NAWAPA – the North American Water and Power Alliance.

The basic idea behind 'NAWAPA' is to capture the surplus waters of the Fraser, Yukon, Peace, and Athabaska river systems in north-western North America and to direct, via an elaborate system of canals, reservoirs and tunnels, the surplus water to deficit areas of Canada and United States.

The St. Lawrence Waterway

The St. Lawrence, with the great lakes, forms a very important commercial route into the heart of North America. The river is, however, ice-bound for about four months every year, and has various rapids and falls which have necessitated the cutting of canals to enable sea-going vessels to reach Lake Superior. Large ocean vessels can pass about a thousand kilometres up the river to Montreal; but here goods have to be transhipped to smaller vessels, because rapids occur, and the canals made to avoid them are not over 3–5 metres deep.

The Canadian government built a 3–5 metres deep canal around the rapids that permitted shallow draft boats to negotiate the St. Lawrence between Lake Ontario and the sea. After the Welland canal and its eight locks were completed in 1931, interest in the Great Lakes – St. Lawrence Seaway was renewed.

The St. Lawrence enters the ocean by a deep estuary due to submergence in the past, but navigation is rendered difficult by the prevalence of fogs and the rapidity of the current. The valley of the St. Lawrence is fertile, and the whole length is lined with villages and towns. Another canal has been made to avoid the falls of Niagara, though a great deal of trade is diverted at Buffalo to the Erie canal and Mohawk-Hudson route to New York. The Sault Sainte Marie or 500 canals were necessitated by rapids between Lake Superior and Lake Hudson, and the traffic on these canals is enormous.

Asia

Asia is not having elaborate system of inland waterways, but rivers in many countries are used as inland waterways.

In China, the rivers have made a significant contribution to the development of commerce. The three great rivers, the Hwang-ho, the Yang-tse-kiang and the Sikiang, cross the country from west to east. China's greatest river is the

Yang-tse-kiang, the most important waterway for navigation in the country. It is doubtful whether there is another equally extensive region of wealth in the world where the people depend as solely upon a single artery of traffic and upon one entrepot as do the inhabitants of the Yangtse basin. About half of the population of China live in this fertile area, utilising the river, its tributaries and its network of canals as their chief means of communication. The Yang-tse-kiang rises in Tibet, and with its tributaries drains the heart of China. It is navigable by steamers up to the port of Hankow. The Sikiang rises in the highlands of Yunan and has a fairly direct course eastward to its mouth. It is navigable for the greater part of its course. The Pei-ho is important for communication and can be navigated up to Tientsin.

Northern India is especially endowed with three large navigable rivers. These rivers are the Ganga, the Brahmaputra and the Jamuna. The Ganga can be navigated by steamers as far as Kanpur from its mouth. This river flows through the most densely populated and fertile plain of India and naturally commands much traffic. Before the development of railways the Ganga was of considerable importance for the movement of goods and persons. The development of railways has greatly reduced the importance of steam navigation, specially in the Upper Ganga. The Lower Ganga is even now very important, and there is traffic all the year round. The Brahmaputra flows through Assam and Bangladesh and is navigable as far as Dibrugarh. Its tributary, the Surma, has made steam navigation possible in Sylhet and Cachar. The Indus in Pakistan is navigable by steamer up to Dera Ismail Khan in the North Western Frontier Province. The river mostly handles wheat, cotton and wool. The frequent shifting of its bed and the formation of sand-bars have caused steam navigation in the Indus to be neglected.

Burma is very fortunate in having a large number of navigable rivers. The Irrawaddy, the most important and the largest, is navigable by steamers for more than 800 km from its mouth and country boats can proceed farther.

Africa

In Africa, some rivers are navigable, that too for a very limited length. The Nile is the most important river in north-east Africa, but its great defect is the succession of cataracts. In its upper course the Nile has rapids and falls; in its middle course there are cataracts. It is navigable in the delta and in its lower course. The rivers of South Africa are of little use for traffic. The Zambesi is navigable for only 350 km, while the Limpopo can be navigated only for a short distance. The Orange is not navigable. In tropical Africa, the Congo provides a magnificent system of waterways. It rises in the highlands between the lakes Tanganyika and Nyasa. But at several places navigation is interrupted by rapids and falls. The Uban, the chief tributary of the Congo, can be navigated almost up to its head. In West Africa the Niger is easily navigable for 500 miles and in the wet season navigation is continued further. The Gambia is navigable for 260 km from its mouth.

South America

South America is having some long rivers but their use as inland waterways is limited. Amazon river is the longest river of the continent. But till now the Amazon system is of relatively little use, because the region through which the river flows is largely forested, sparsely populated, undeveloped and largely unexplored. The

Orinoco which flows through Venezuela is a long waterway. But the most useful in South America is the Parana system which penetrates the heart of Argentina, Paraguay, Uruguay and South Brazil. In the southern side of South America the river Rio Negro drains the sheep-rearing land of Patagonia.

Australia

Australia is deficient in waterways. Her river-system consists of small streams flowing from the highlands to the coast, thus not suitable for navigation purpose. The two most important rivers are Murray and Darling. Darling river remains almost dry during winter and spring seasons. River Murray is partially used as a waterway.

Ocean Transport

Ocean transport is the most important water transport, because it has certain advantages over land carriage. The sea offers a ready-made carriageway for ships which, unlike the roadway or railway, requires no maintenance. Water surfaces are two-dimensional and, although sea-going vessels frequently keep to shipping lanes, ships can travel, within a limited number of constraints, in any direction. Because of floatability and reduced friction, ocean vessels are capable of carrying far greater loads and far greater weights than can be handled even by the longest railway train, the most powerful lorry and trailer, or the largest aircraft; accordingly, ocean transport is usually the cheapest of all forms of transport. Again, except for fog and floating ice, and occasionally stormy weather which may hinder progress, ocean-going vessels have fewer physical obstacles to surmount than those which so often handicap overland transport.

Ships have been used for transport right from early times. During Graeco-Roman times a fundamental distinction was made between longships or galleys, used for military purposes, and round-ships for trade. The Vikings had a similar distinction. During more recent times ships have shown an even greater specialisation and several distinct types of commercial vessels gradually evolved. Today about half a dozen main types of merchant ships are recognised – passenger liners, cargo-liners, bulk-carriers, tramps and coasters, and short-sea traders.

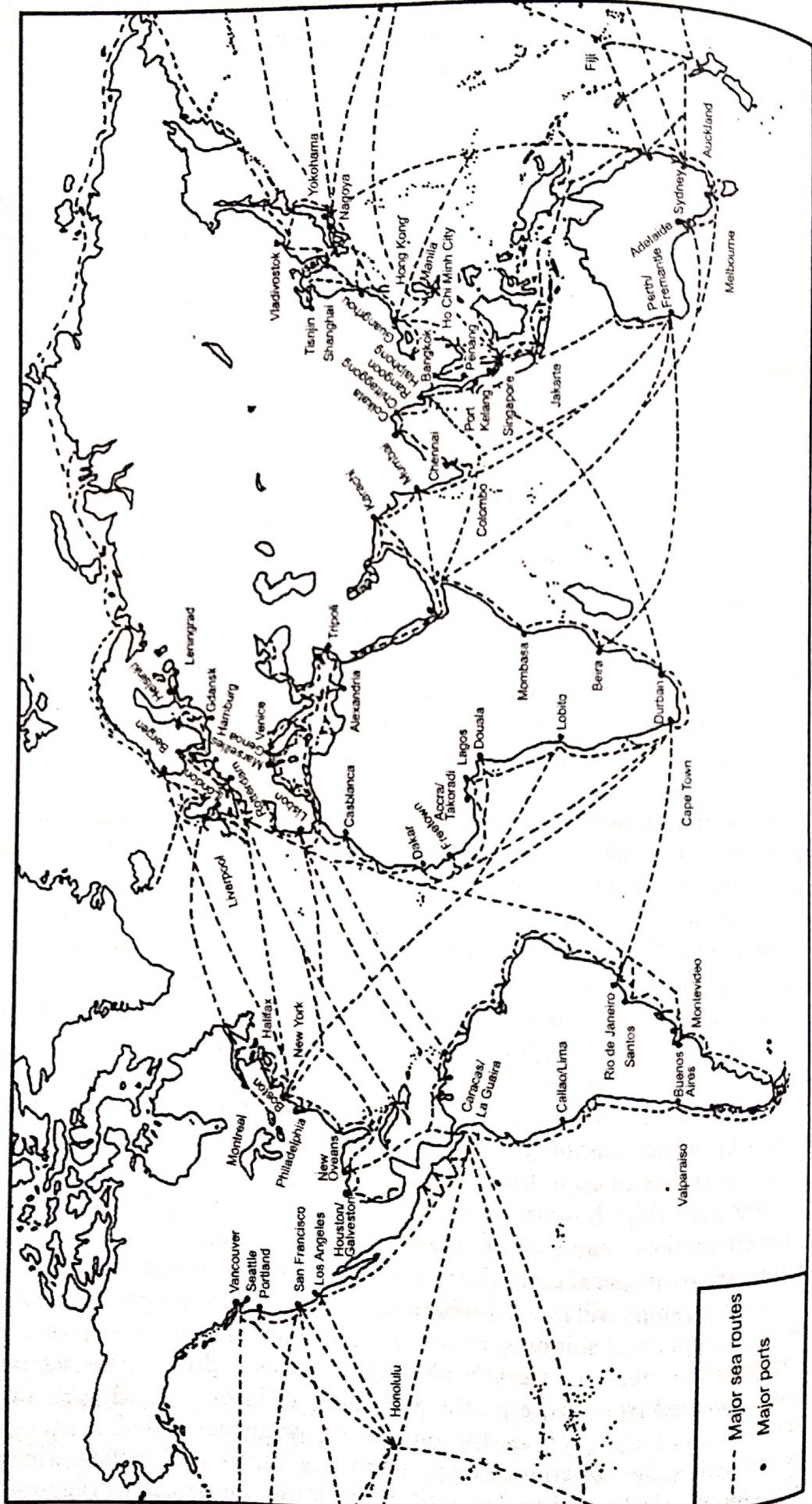
The most spectacular development, however, has been the appearance of bulk-carriers, the most important of which are tankers, the product of the oil age. Recent years have witnessed a tremendous growth in the size of tankers, a number of which now exceed 5,00,000 tons dead-weight. Today, more than half of the world's merchant shipping tonnage comprises tankers, a fact indicative of the great importance of oil in the modern world.

Although ships have freedom of movement and are capable of going virtually anywhere on the ocean surface, they tend to keep to certain "lanes". They do so because of: (i) physical conditions, and (ii) economic considerations.

Clearly, ships will go only where there are goods or people to be carried and the most important shipping routes are those linking the most productive and most populous regions. Certain physical conditions also help to determine the routes followed by ships, e.g., the availability of harbours and ports on coasts, weather conditions such as fog and storm occurrence, and oceanographical factors such as sea ice and icebergs, submarine banks, and shallow waters.

The principal ocean trade routes of the world are as follows (Figure 13.6):

Figure 13.6
Major Ocean Trade Routes of the World



The North Atlantic Ocean Route

The North Atlantic Ocean Route has the greatest traffic of all ocean routes. Nearly one-fourth of the tonnage of the world's merchant vessels serves this route. In volume and variety of cargo, this route far exceeds any other. This route connects the ports of western Europe with those on the east coast of North America. These two regions are the most populous and highly developed regions in the world. North America and western Europe are the world's greatest producers of goods of quantity and diversity. Ports on the western coast of Europe are Glasgow, Liverpool, Manchester, Southampton, London, Rotterdam, Bremen, Bordeaux and Lisbon. Ports on the eastern coast of the USA are Quebec, Montreal, Halifax, St. John, Boston, New York, Baltimore, Charleston, Galveston and New Orleans.

This oceanic route is the busiest trade route of the world. Large quantities of manufactured items: textiles, chemicals, machinery, fertilisers, steel, wine, etc., are exported from these ports across the North Atlantic to the United States and Canada.

The exports of Canada and the USA to Europe are timber, fish, wheat, raw cotton, tobacco, oil, machinery and vehicles, metals, paper and chemicals.

The Suez Canal or Mediterranean Asiatic Route

This route is second to the North Atlantic in respect of volume of traffic. It commands the markets of eastern Africa, Iran, Arabia, India, the Far East, Australia and New Zealand. In fact, the route passes through the heart of the world and touches more lands and serves more people than any other route. Throughout its many ports of call, it reaches about three-quarters of the total population of the globe. After crossing the Red Sea, the route follows two directions – one along the eastern coast of Africa to Durban; another to farther east – to India, Australia, etc. Ports of departure are London, Liverpool, Southampton, Hamburg, Rotterdam, Lisbon, Marseilles, Genoa and Naples. The ports of call are Aden, Mumbai, Kolkata, Rangoon, Penang, Singapore, Manila, Hong Kong, Perth, Adelaide, Melbourne, Sydney, Mombasa, Zanzibar, Mozambique and Durban.

This route is used by Asiatic countries to send raw materials and some food products to the western markets and receive in return manufactured articles – the products of the Far East are rice, tea, sugar and silk; those of India are coffee, tea, pig iron, manganese ore, jute goods, indigo, spices, cotton, teak, silk, skins, leather and oil-seeds and those of Middle East are petroleum, coffee, and dried fruits. From Australia meat, timber, wheat, flour, fruit, wool, butter and wine are sent. China, Australia, New Zealand and countries of South and South-East Asia now use this route for both export and import of commodities.

The Cape of Good Hope Route

This route was once the subsidiary alternative to Suez Canal route, but because of its long and circuitous journey, was avoided by most of the shipping companies. During the closure of Suez Canal in 1967 all the ships had no choice but to take this route. Even after Suez Canal reopened in 1975, much trade continues to follow this route because tankers and other vessels nowadays are much larger. As the Suez Canal can only accommodate ships of around 20,000 tons capacity and toll charges are high, the Cape route is growing in importance. It has several other

advantages. With the greater economic development of the recently independent African nations and the exploitation of their rich natural resources such as gold, copper, diamonds, tin, chromium, manganese, cotton, oil palm, groundnuts, coffee and fruits, the volume of traffic round the Cape of Good Hope and from ports in both East and West Africa is on the increase.

The Panama Canal: West Indian Central American Route

The construction of Panama Canal was completed in 1913. The Panama Canal is 'the gateway to the Pacific' and eliminated the long and hazardous voyage round the Cape Horn. It has benefited on both Atlantic and Pacific seaboard, facilitating trade in minerals, oil, foodstuffs, raw materials, and manufactured products. But the greatest benefits have accrued to traffic between the east and west coasts of USA. The Panama route has also greatly facilitated trade in the West Indian islands and the Pacific states of North, Central and South America, especially the Andean states which are rich in mineral resources and have good markets in North America. The Latin American states import manufactured goods and mining equipment from the USA and the western European countries. Much trade destined for the Far East, the Pacific islands and Australasia from North America and Western Europe also goes through the Panama Canal. With the greater economic development of East Asian countries especially China, Japan and the South-East Asian states, the Panama route is assuming a greater role in the exchange of products between the East and West. The distance saved from Auckland to New York via Panama, instead of Cape Horn, is more than 4,000 km.

The South Atlantic Route

This route leads to West Indies, Brazil and Argentina. The chief ports of call on the route are Kingston (Jamaica), Havana, Vera Cruz, Tampico, Pernambuco, Bahia, Rio de Janeiro, Santos, Montevideo, Buenos Aires and Rosario. The exports along the route are sugar, bananas, raw cotton, mahogany, tobacco, coffee, grain, wool and meat, while the imports are manufactured goods.

This route maintains trade connections between Europe on the one hand and West Indies, Caribbean seaboard, Brazil, Uruguay and Argentina on the other.

The Trans-Pacific Route

There are several routes in North Pacific which converge at Honolulu for refuelling and servicing. The direct route further north is a great circle which links Vancouver and Yokohama without calling the Hawaiian Island, reduces the travelling distance by half. The North Pacific trade include Vancouver, Seattle, Portland, San Francisco and Los Angeles on the American side, dealing with wheat, timber, paper and pulp, fish, dairy products and manufactured goods. The destinations across the 7,200 km (4,500 mile) wide Pacific are usually Yokohama, Kobe, Shanghai, Guangzhou (Canton), Hong Kong, Manila and Singapore. The east-bound trade from East Asia to North America consists mainly of manufactured goods, e.g., textiles, electrical equipment, from Japan, Hong Kong, S. Korea, and Taiwan, and tropical raw materials from South-East Asia, e.g., rubber, copra, palm oil, teak, tin and tea. In addition to international links the North Pacific is an important domestic routeway from the US mainland to the isolated states of Alaska, in the north, and Hawaii in the mid-Pacific.

In the *South Pacific*, the traffic consists mainly of ships travelling via the Panama Canal between either West Europe or North America and Australia, New Zealand and the scattered Pacific islands. Goods transported are mostly wheat, meat, wool, fruits, dairy products and manufactured articles.

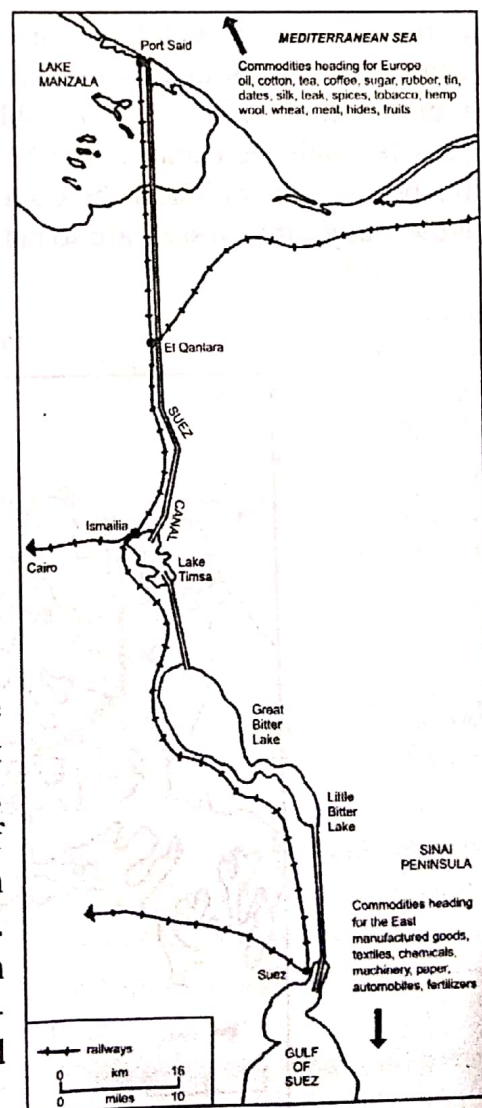
The other important routes are eastern North American-east South American (from New York to Cape Sao Roque), North American-western South American (from New York to Punta Arenas via Panama Canal), North American-Australasian (from New York and Vancouver to Sydney and Wellington via Honolulu), etc.

The analysis of ocean transport cannot be completed without detailed description of Suez and Panama Canals. These two canals have changed the entire pattern of oceanic trade, therefore, it is essential to know the characteristics and importance of these canals.

The Suez Canal

The Suez Canal is one of the great international waterways of the world – cuts across the Isthmus of Suez and provides navigational facilities between the Mediterranean Sea and the Indian Ocean. The history of a canal connecting the Mediterranean with the Red Sea dates back to 13th century B.C. when Nile-Red Sea canal is known to have been in use until the end of 8th century AD. From 16th century onward one or the other of European powers became interested in the idea of either reopening the old waterway or cutting a new one from the Mediterranean. In 1834, Ferdinand de Lesseps, a member of the French Consular service at Alexandria was interested in the Suez Canal scheme. In 1854, he discussed the project with the Viceroy of Egypt (Khedive) and got his approval. A concession to run for 99 years from the date of the canal's opening was granted to de Lesseps, authorising him to form an International Company for the purpose of constructing a waterway. The excavation was started in 1859 under de Lesseps, who took full ten years to construct the canal. It was opened in November, 1869. It is about 160 km long (including distance of lakes) and is 11 to 15 metres deep. The width of the floor is 40 m and varies at the surface. Suez Canal links the Mediterranean Sea with Red Sea. Port Said is located at Mediterranean Sea; while Port Suez is on the Red Sea.

Figure 13.7
The Suez Canal



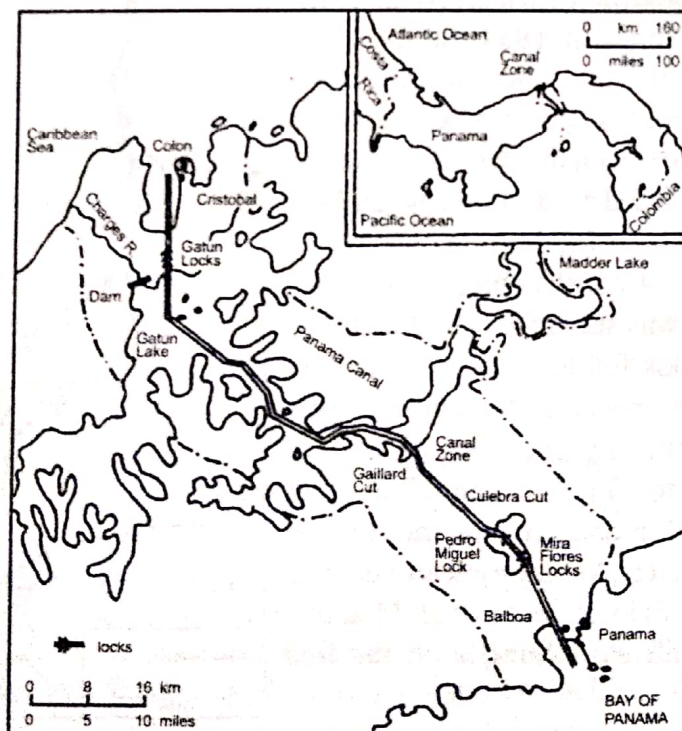
As a ship enters the canal from the Mediterranean Sea, it will pass Port Said, one of the greatest ports in the world and proceeding south will enter Lake Tunisa on the bank of which is the city of Ismailia. From Lake Tunisa to Suez city, a ship will pass through Geat Bitter lake and Little Bitter lake.

No single human enterprise during the past century has done more to affect the destinies of nations through a physical geographical change than the Suez Canal. The opening of Suez Canal route saved approximately 5,820 kilometres on the voyage from London to Mumbai as compared to the Cape route. The opening of Suez Canal had a tremendous effect not only on world trade and commerce but also on international politics, besides opening up to western countries a new route to Africa, Asia and Australia.

The usual trade route between the eastern coast of North America and the Far East was through the Cape of Good Hope. The Suez Canal saved a great deal of distance by diverting the traffic from the Cape of Good Hope route to itself and thus, benefited North America greatly. More than 12,000 vessels pass through the Suez canal every year. The Suez Canal has provided not only the fastest but also the most economical line of transit between Europe and the East. Politically the Suez route is vital because of the oilfields in the Middle East countries on whose products the economy of western Europe is dependent.

There are some problems of the Suez Canal. The canal needs improvements in regard to depth, width, diversion to avoid crossing of ships in the narrow part of canal. The deposition of silt that comes along winds blown from desert also needs regular cleaning. The second problem is the high canal dues levied on ships which pass through the canal. It has been observed that when speed is not essential, many cargo liners follow the Cape of Good Hope route to avoid the high dues. Now many cargo vessels are so big in size that they cannot pass through the Suez

Figure 13.8
The Panama Canal



Canal. Political instability in adjoining states of the canal is also a cause of concern. Although, Suez Canal according to international convention is free and open, in time of war as in time of peace, to every vessel of commerce or of war, without distinction of flag.

The Panama Canal

The Panama Canal connects the Atlantic and the Pacific oceans by means of two bays, an artificial lake, a natural lake, and three systems of locks. It has been constructed across the narrow Isthmus of Panama where the long Continental Divide dips to one of the lowest points. The canal is 72 km long from deep water to deep water in the oceans. It was opened on 15 August, 1914 (Figure 13.8).

All the locks are double, so that ships can pass in both directions without any congestion of traffic. The depth of the channel varies from 12 to 26 metres and the width varies from 91 to 305 metres. The time taken to pass through the canal from Panama to Colon is 14 hours.

The Panama Canal passes through a rough country and the engineering difficulties have been much greater than in the case of the Suez Canal, which passes through a level country and needs no locks. The Panama Canal generates its own hydroelectric power with which not only lighting of the region is done, but also electric locomotives are supplied to pull ships through the locks.

The Panama Canal is 'the gateway to the Pacific'. It has benefited countries on both Atlantic and Pacific seaboard, facilitating the trade in minerals, oil, foodstuffs, raw materials and manufactured products. Its greatest benefits have accrued to traffic between the east and west coasts of the United States. The canal shortens the distance between New York and San Francisco by about 12,596 km by sea, and lessens very considerably the distance between western Europe and western America, and between the northern and middle parts of East America and East Asia.

It also slightly shortens the distance between Europe and New Zealand, but it does not lessen that between Europe and Asia or Europe and Australia. Eastern North America and north-western Europe very definitely gained as a result of the canal, for they were placed much nearer by this route to all of western North America, western South America, and New Zealand. For eastern North America the canal has meant a great reduction in the distance to Japan and to all of China north of Hong Kong, a factor that has unquestionably contributed to the rapid growth of trade with East Asia.

Comparison between Suez and Panama Canals

Both Suez and Panama Canals are the most important ocean canals of the world and each canal has had its own advantages. From the comparison point of view following points are notable:

- (i) The Suez route is well-supplied with coaling stations, etc., as there are plenty of islands and other points of call. The Panama route suffers for want of enough islands and halting stations as the Pacific is a dreary ocean with little commerce.
- (ii) Coal is easily and cheaply available on the Suez route, specially as coal occurs in many of the areas served by the Suez route.

The Panama route serves regions which are deficient in coal. It has, however, considerable amount of oil.

- (iii) The Suez route serves some of the most thickly populated areas and carries therefore a much larger traffic than the Panama route which generally serves poor mountainous or desert regions like those on the east coast of North America or South America.
- (iv) The Suez Canal is longer, has no locks, and has cost less than the Panama Canal. It is not so deep, however, the practice of tying up, so annoying in the case of the Suez, is not necessary in the case of the Panama Canal.
- (v) The Suez Canal dues are higher than those of the Panama Canal.

Other important ship canals of the world are: *The Sault Sainte Marie Canal*, (called Soo), the *Manchester Ship Canal*, the *Kiel Canal*, the *North Sea Canal* between Amsterdam and the North Sea, and the New Waterway between Rotterdam and the North Sea.

AIR TRANSPORT

The use of aircraft and development of air transportation belong to the 20th century. The countries which took the lead in developing commercial air routes in the world were France, Belgium, Netherlands and UK. These countries, after the First World War, put to use their experience of flying and the accumulated planes for commercial aviation, primarily for the purpose of maintaining communication with and defence of their colonies. The USA entered the field of commercial aviation after 1927. Lack of colonial interest was one of the factors for her delay. The real progress of air transportation, however, started after 1946. The World War II gave a great impetus to the development of aerial transport and the period between 1946 and 1956 was characterised by quick development of new equipment and by a big upsurge in the volume of air travel. The greatest innovation of the period was the application of jet propulsion to transport aircraft.

Air transport differs from all other forms of transport in that it is three-dimensional. Since aircrafts are not tied to the surface and have the ability to fly above terrestrial obstacles, air routes, in a purely theoretical sense, can be laid in any direction and, in fact, it is commonly said that aeroplane has the freedom of the air and a freedom of action denied to any other form of transport. Such freedom however, is largely illusory. In the first place, movement for commercial purpose, is normally channeled along carefully prepared routes; secondly, movement may be restricted by political considerations, some countries banning flights across their territory for security or other reasons; thirdly, aircraft need airports just as surely as ships need harbours and port installations and aircraft are tied more closely to ground facilities than is usually imagined; and, fourthly, weather conditions impose a greater control upon air transport than upon any other form of transport.

In the early days of air transport, when aircraft had a relatively restricted range of flight due to their size, speed and limited fuel carrying capacity, air routes were so designed as to avoid extensive ocean crossing, high mountains, uninhabited deserts, and vast forest areas. Hence, the very barriers which impeded human travel on the earth's surface also restricted man's movement by air. However, as a result of the greatly improved performance of aircraft and their greater reliability, physical features in themselves now place no limit upon the choice of routes.

In air transport, weather conditions are a limiting factor. But due to technological developments, aircraft have begun to use the stratosphere where they can fly "above the weather". Radar, de-icing techniques, beacons for night flying, and host of other inventions and aids have helped to combat the weather. But, notwithstanding all these things, it must be emphasised that low cloud, ground mist, fog, ice, dust-storms and other weather phenomena, which either interfere with visibility or affect the performance of the aircraft, still hinder flying and create hazards.

Air routes today are primarily determined by: (i) adequate ground facilities for operation, and (ii) availability of traffic for economic working.

Air transport is still, in general, costly. The high cost of air transport is largely the result of the expensiveness of the vehicle and the motive power. The total amount of freight moved by air is still small, less than 2 per cent of the total world figure. Air transport is best suited for the carriage of commodities which are low in bulk but high in value. At the present time most of the air freight is actually carried in the holds of passenger aircraft. But, the expansion of high-technology industries in the Pacific Rim, in North America and in western Europe has generated a growing demand for air cargo services and the highest growth rates have been recorded on US-Far East routes. On an average, 740.2 million tons is hauled as air cargo. The leading international airports handling over 0.5 million tons of freight are as follows:

Table 13.1
Leading international airports of the world

<i>Airports</i>	<i>Thousand tons</i>	<i>Airports</i>	<i>Thousand tons</i>
New Tokyo International	1,361	Chicago O'Hare	749
New York JFK	1,207	London Heathrow	698
Frankfurt	1,084	Seoul	631
Los Angeles International	1,025	Singapore Changi	621
Miami International	908	Paris CDG	618
Hong Kong International	802	Amsterdam Schiphol	585

Air services are of two main kinds:

- (i) short-distance services such as those operating between important centres in a country or making short sea crossings, and
- (ii) long distance services such as the transcontinental and transoceanic flights.

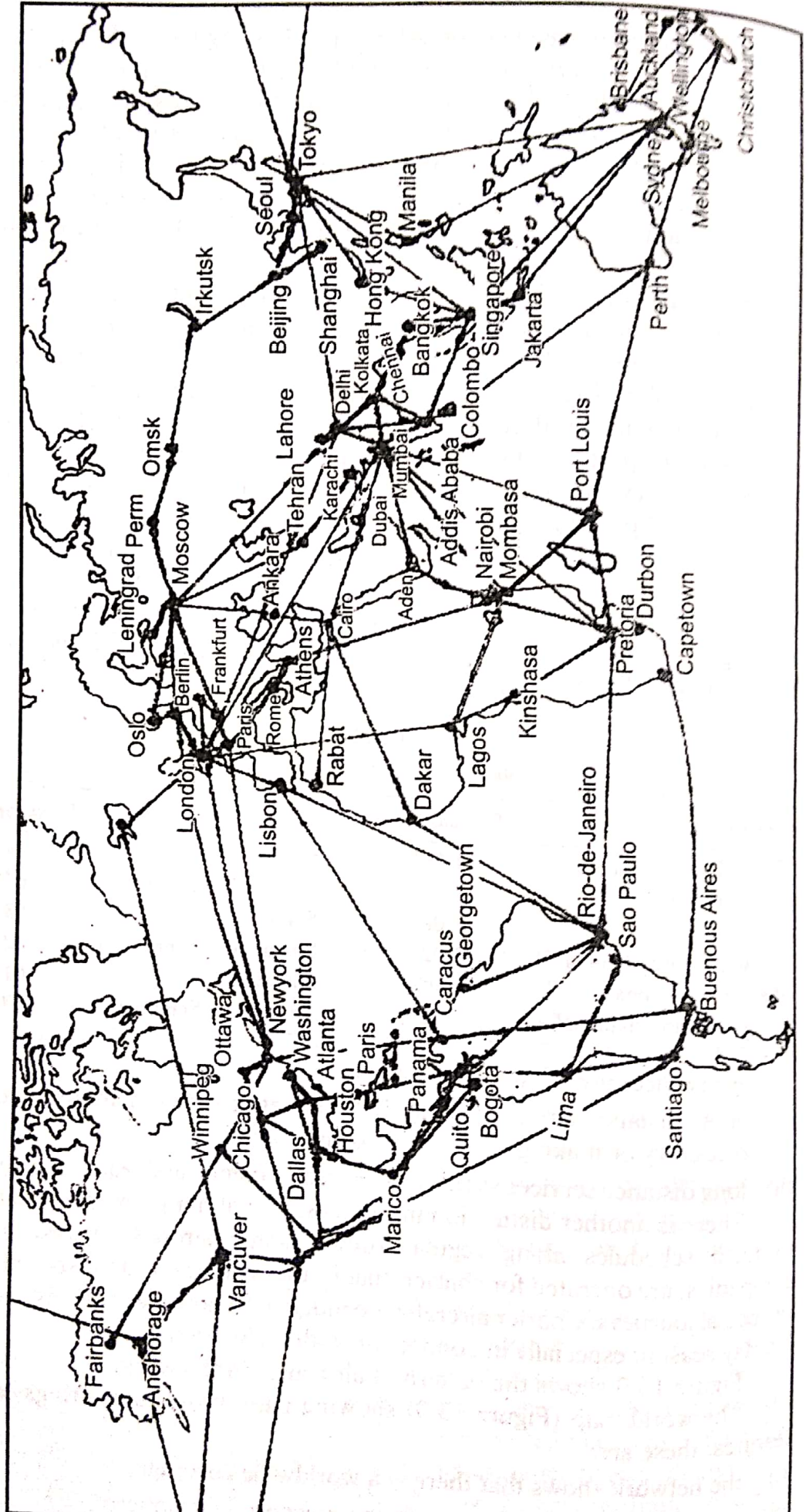
There is another distinction in services, too: although most aircraft operate to fixed schedules along regular routes, some aircraft, owned by private companies, are operated for charter, that is, they can be hired for special purposes or special journeys. Charter aircrafts are much used nowadays during the summer holiday season, especially in connection with inclusive tours.

Figure 13.9 shows the pattern of air routes in the world:

The world map (Figure 13.9) showing pattern of routes brings out certain features; these are:

- (i) the network shows that there is a worldwide coverage;
- (ii) an east-west girdle of routes in the northern hemisphere;

Figure 13.9
Major air routes of the world



- (iii) longitudinal extensions from the latter into the three southern continents;
- (iv) a great focusing of routes in three particular regions: western Europe, eastern USA and the Caribbean, and South-East Asia; and
- (v) several important foci from which numerous routes radiate, e.g., New York, Chicago, Los Angeles, Washington, Seattle, San Francisco, London, Paris, Berlin, Frankfurt, Rome, Moscow, Cairo, Delhi, Mumbai, Kolkata, Bangkok, Singapore, Hong Kong, Tokyo, Sydney, etc.

The greatest development in air transport has taken place in United States of America. USA is a country of long distances so that there are no political frontiers with all the customs formalities, to be crossed by aeroplanes. The Atlantic and the Pacific coasts of the United States are among the most developed parts of the country, and the quickest way to connect these areas is by air. Because of this the number of people wishing to use this quick method of contact between the two far-flung borders of USA is very large.

United States alone is served by about 9,000 air terminals, has over 1,50,000 registered civil aircrafts and accounts for almost half of the world's air passenger traffic.

In Canada, the largest airline company is the Trans-Canada Airline, with Montreal, Toronto and Vancouver as the busiest air terminals.

In Europe, most of the countries have their own national airlines. After US, the greatest volume of air traffic is found in Europe. The major air terminals of Europe are London, Paris, Rome, Madrid, Berlin, Warsaw, Vienna, Geneva, Moscow, etc. England-Australia air route is one of the busiest and important air routes. This route starts from London and follows Marseilles, Athens, Alexandria, Cairo, Gaza, Baghdad, Bahrein, Sharjah, Karachi, Delhi, Kolkata, Rangoon, Bangkok, Penang, Singapore, Batavia, Darwin, Brisbane and finally reach to Sydney.

Russian international air routes are mostly controlled by Moscow, Leningrad, Novosibirsk, Irkutsk, and Vladivostok. Russia and other countries of former Soviet Union are also well-connected by air service.

Africa is served by international airlines following the East African route through London, Rome, Cairo, Khartoum, Addis Ababa, Nairobi, Johannesburg with Mauritius, Sri Lanka and South-East Asia. The Central African route is through Paris, Algiers, Kano, Lagos, Kinshasa, Johannesburg, Durban or Cape Town. While West African route goes through London, Madrid, Casablanca, Dakar, Freetown, Monrovia, Accra and Luanda. In addition many African countries have their own air domestic service.

Most Asian countries have their own international airlines and many have domestic air service. Important international routes run across the monsoon fringe of Asia and Beirut, Tehran, Karachi, Mumbai, Delhi, Kolkata, Bangkok, Singapore, Hong Kong and Tokyo are all important international airports.

India's location from the point of view of air routes is good, because of its en-route location between Europe, Asia, Australia and Africa. India has air transport agreements with 93 countries and her flights are regularly scheduled to these countries. Air India, and Indian Airlines are the main air lines which operate regular international and domestic air service. The major international airports of India are: Indira Gandhi International (Delhi), Sahar (Mumbai),

Meenambakkam (Chennai), Dum Dum (Kolkata) and Tiruvananthapuram. Besides these, there are 92 major international and minor aerodromes meant for domestic and other flights. Now, some private airlines are also operating in India.

In China the first air flight between Shanghai and Chungking took place in 1928, but very little progress has been done till 1950. Considerable progress was made in air transport between 1950–1958. Today, there is a well-developed network in China proper and most of the principal cities have air links. China now has external air links with several other countries. Beijing, Shanghai and Canton are the great hubs of the airways network. But China is still having relatively lesser air transport facilities.

Air transport is well-developed in Japan and operates internal and international services. Tokyo is the focal point of international air transport.

The other countries of South-East Asia are also having international aviation. Similarly, countries like South and North Korea, Pakistan, Bangladesh, Sri Lanka, etc., are well-connected with air transport.

The Central and South American countries have developed air transport and all the capital cities are connected with international flights. The main focal points of air transport are Caracas, Bogota, Lima, Santiago, Buenos Aires, Sao Paulo and Rio de Janeiro.

In a large country like Australia where population is less and widely scattered and half of the people live in or near six major cities, the development of internal air service has been of enormous value. Thus, Australia has a well-developed internal air service and is also well-connected with other parts of world. Sydney is its most important international airport. New Zealand has also well-developed internal and external air transport facilities. Auckland, Wellington, Christchurch and Dunedin are the principal airports of New Zealand.