UNIT 34 TECHNOLOGIES OF WARFARE AND COMMUNICATION

Structure

34.1 INTRODUCTION

The history of warfare and its technologies tends to be Euro-centric, because it was, after all, the Europeans who had conquered most of the world, and the weapons and modes of warfare invented by them which still dominate the planet. As Europe made a transition from medieval feudal age to modern industrial age, it started evolving a system of warfare which was distinguished by its disciplined application of existing technologies to wars. Generally we single out the invention of gunpowder as the turning point in the history of tactics and strategy of warfare. But as we will see, new technology was only peripheral to the essential early phase of military revolution in Europe. There is no doubt that firearms induced many changes in the institutional life of armies. It reduced the mounted knights and cavalry from leading actor on the battle field to irrelevance by fifteenth century. But apart from technology, these changes were also a result of professionalisation of army that gradually transformed small feudal levies into standing armies comprising of mercenaries under the direct control of absolute monarchs. Similarly transport, navigation and changes in communication also entailed many social changes. While the role of horse declined on the battlefield, it remained the chief and efficient means of transport on land-in the pre-modern Europe.

The main focus of this unit is to discuss the changes in technologies of warfare and communication in the pre-modern Europe. We will analyze the role of military innovations and their impact on tactics, strategy and organisational aspect of war-machinery. Finally, how these changes and transformations in technologies and army affected society and its institutions, too, will be examined.

34.2 REVIVAL OF INFANTRY AND ITS IMPACT

Cavalry was the dominant arm of medieval European armies. It was the basis of power of the feudal lords and noblemen. The average subject in the medieval

peasant society could not take part in cavalry warfare because only wealthy feudal landowners could afford the horses and armour required. But with proper training and discipline, a peasant could certainly have been turned into an effective infantrymen. However, infantry implies large number of soldiers in the fighting ranks. Hence, changes in the size of army could mean placing military power in the hands of ordinary peasants. Such changes in the composition of armed forces would have had revolutionary consequences for the rigidly stratified feudal societies.

The revival of infantry, however, was related to changes in technology of warfare itself. Before the Hundred year's war, (between England and France, 1337 – 1453) armies of Western Europe relied heavily on the crossbow, despite religious prohibitions against it because of its lethal power. It was a mechanical device which, as its clock work was wound against a spring, stored enough energy to discharge a heavy bolt with precise accuracy and to long range when a release mechanism, a trigger, was pulled. During 14th century, it was in common use on the battle fields as a potent weapon of war because of its bolt's power to pierce armour at medium and short range. The mechanism and shape of the crossbow lent itself to adaptation for gunpowder use. During fourteenth and fifteenth centuries the English used longbow men to great effect. At the climax of the hundred years' war, over half of the English infantrymen were longbow men. They outclassed crossbowmen, who were not employed in large number after the 15th century in European armies. In the next century, the longbow, in turn, gave way, though only slowly, to small fire arms and muskets. In fact, the first signs of shift to infantry came during the Hundred Years War in which English longbowmen protected themselves from cavalry charges and repeatedly destroyed French formations of heavily armoured cavalry. In an attempt to protect themselves, the mounted knights were first driven to use plate armour – the classical iron pajamas worn by the last few generations of European cavalry. But they could not protect their horses all over with similar armours – the weight would have been too much for the horse. With their horses injured, the knights were forced to dismount and wearing about 60 pounds plate armour each, and attempting to charge on foot like infantrymen presented a pathetic sight. Cavalry was literally dead. Other elements of infantry – uniforms, numbered units, flags to identify them and keep them together, regular drill, marching in step etc. were required to mould soldiers into professionals and inculcate discipline on the battlefield.

The European States in 15th and 16th centuries reinvented the infantry armies of classical antiquity – now in a new political and social context. It was the absolutist rulers and monarchs, striving to increase the power of State through centralisation and by undermining the old feudal aristocracy, who fostered the new infantry armies. They were found more effective and saved the king from having to call on the feudal levies of the barons in times of war. Ideally, the monarch would have liked to hire or conscript his new army from his own population. In fact, there were several attempts to create national militias under the control of Central government. For example, there were 4,65,000 men registered in the Spanish militia in 1694. These attempts were not so successful due to resistance of peasants and aristocracy. So the absolute rulers employed large number of mercenaries, who would fight under contract for any state ready to pay them. The export of companies of trained mercenary soldiers became practically a national enterprise in the poorer parts of Europe like Switzerland.

The increasing reliance on fire power in battle – whether with archers, field artillery or musketeers – led not only to the eclipse of cavalry by infantry in most armies, but also were accompanied by a dramatic increase in the size of most European armies. In the sixteenth century, most States had armed men in thousands, with the exceptions of Charles V of Spain whose army was estimated at 1,50,000 men. By 1630s, however, most of the leading European powers employed about 1,50,000 soldiers each. By the end of seventeenth century, French army had about 4,00,000 soldiers. However, the size of army was still determined by the cost of maintaining mercenaries.

34.3 FIREARMS, GUNPOWDER AND FORTIFICATION

The use of gunpowder and introduction of firearms completely altered the techniques of warfare and methods of fortifications. The tactics of warfare in the battle field also underwent major changes. We need to discuss them in some details.

34.3.1 Gunpowder Revolution

The explosive results of mixing saltpetre, sulphur and charcoal were first discovered in China. The Chinese were making use of gun-powder from 13th century onward. Mongols adopted this innovation and probably transmitted it to the Europe. The triumph of longbow in Europe was also accompanied in 14th century by adoption of gun-technology. In the early 1320s, first real metal guns were being cast in Europe. From that point onward, the Europeans took the lead in developing firearms. Countries of Western Europe and the Turks competed with one another in production of bigger and better guns. The improvement in metallurgy and gunpowder also improved the accuracy and efficiency of cannons. By fifteenth century gun technology had made enormous advances. Cannonballs had replaced arrows and guns had assumed tubular forms. Nevertheless, the use of cannon remined confined to siege warfare. The fall of Constantinople in 1453 was result of battering down of its fortification by the Turkish cannons. The cannons with which the French kings and the Ottoman Turks knocked through defensive fortifications of their enemies suffered from many serious handicaps. They were large, heavy and mounted on immobile platforms. As a result they could be brought into action only on the territory their owners already controlled. For cannon to become a more useful instrument of military campaign they had to be lightened enough to be transported on wheels at the same speed as the army that accompanied them. Only with such a mobile capacity different units of armed force (infantry, cavalry and artillery) be integrated otherwise artillery might be captured easily by the enemy. By the end of fifteenth century, French had designed guns that combined the elements of mobility and manoeuvrability.

34.3.2 Changes in Fortifications

The strength of medieval fortress had been based on the height of its walls and their thickness. They had withstood the pressures of enemy as it was difficult to scale the crest and thickness made the siege tactics less effective. Even use of mines was difficult task that ditches and moats easily defeated. The new mobile cannons, because they could be rapidly brought into action close to a wall, and then handled to fire accurately in predictable area of impact, transferred

the effect of mining to artillery. Iron cannon balls, directed at the base of a wall in a horizontal pattern of attack could rapidly cut a channel in the stone work, the cumulative effect of which was to use the structure of the wall against itself the higher the wall more quickly it would become unstable and wider the breach it left when toppled. The fall of the wall automatically filled up the ditch at its foot with rubble, thus providing passage for an assault party. This necessitated a response in the form of improvisation to strengthen old fortifications. At Pisa, for instance, fortification – engineers contrived an inner earthern bank and ditch behind the city's stone wall. However, an alternative system of fortification was needed. The basic concept in the new kind of fortification of castles was simple. As the mobile cannons did maximum damage to the high walls, new walls designed to resist them were to stand low. However, a fortress so built was open to escalade. A storming party of enemy-troops with ladders to sweep over the crest could easily get into the interior of fortress by surprise attack. The new system of fortification, therefore, incorporated features that resisted bombardment of cannon balls and held the enemy's infantry at a distance. The solution to this problem of surrounding heights while acquiring depth was angular bastion, which stood forward of the walls, dominated the ditch or moat, served as a fire platform for defender's cannons and firearms, and was strong enough not to be battered shapeless by a concentration of enemy fire. The most suitable design was with four faces: two forming a wedge that pointed towards the surrounding countryside so as to present a glancing surface to enemy fire, and where counter-attacking artillery could be mounted, and two that joined the wedge to the wall at right angles, from the rampart of which defenders could use cannon and firearms to sweep the ditch and stretches of wall between the bastions. The new bastion fortress were erected at enormous cost and labour but they restored the advantage of defence over offence as rapidly as cannons had reversed it at the end of fifteenth century.

34.3.3 Use of Firearms and Military Tactics

The use of firearms meanwhile grew more varied. In the fifteenth century, the hand grenade became a standard military weapon, and special battalions of 'grenadiers' were trained to throw bombs in enemy-lines. The most remarkable innovation of 15th century was a hand gun – an ancestor of the modern rifle. The French **arquebus** was its most typical model. Initially the weapon was awkward and ineffective but it was improved in the 16th century and became an effective weapon in the French-Spanish Wars. The heavier, longer and more lethal musket with larger range was also discovered during this period. The early musket needed two men and a support stuck in the ground for proper manipulation and targeting, but gradually it grew shorter and more wieldy. In the hands of an expert gunner, it could reach a target at 500 yards – about 200 yards beyond the range of longbow. The performance of early firearms, however, still left much to be desired. A well-trained archer could discharge ten arrows a minute, but the **arquebus** of the early 16th century took several minutes to reload. The attractiveness of small fire arms was because of little training required to use them. Therefore, the introduction of the musket in the 1550s, beginning with the Spanish army in Italy, accelerated the process. Gradually, the musketeer became the master of battle field and drove off most other specialists. Even though a good archer could still fire several arrows in the time it took to load a musket, the use of firearms and muskets ushered in a revolution in the field warfare. English persisted with long-bowmen well into

the seventeenth century, but most of the armies shifted to musket. The process was speeded up when the dangerous and inefficient matchlock, an attachment for priming (placing gun powder and connecting it with fuse) and firing both hand gun and musket, began to be replaced by more efficient wheel-lock. But although archers gave way to musketeers, pikemen (pike was a long wooded shaft with pointed steel or iron head) continued. In the course of fourteenth and fifteenth centuries, the Swiss army exhibited that tightly formed squares of pikemen could defeat both cavalry charges and attacks by other infantry units. It was now the pikemen who protected the musketeers. The rate of firing from muskets was very slow. By the beginning of seventeenth centuries, an experienced musketeer could get off one round every two minutes. It could mean only one round against a cavalry charge and the onset of hand-to-hand combat. The situation could be salvaged by improving the musket's accuracy through rifled guns.

Another strategy for increasing the musketeers' rate of fire was evolved in the 1590s by the Commanders of the Dutch army, Count Maurice and William Louis of Nassau. They found that if their men were drawn up in a series of long lines, the first rank firing together and then retiring to reload while the following ranks came forward and did the same, then a continuous hail of fire would be maintained to keep check on the advance of enemy troops. This came to be known as the 'Volley' technique. The use of volley-fire changed the battle tactics. Now it became necessary for armies to spread out during battle, both to maximize the effect of their outgoing fire and to minimize the target for incoming fire. It also placed greater emphasis on the ability of entire tactical units to perform the motions necessary for volley firing both swiftly and in unison. This required prolonged practice and drill. Troops had to be trained to fire, countermarch, load and manoeuvre all together. Gustavus Adolphus of Sweden in seventeenth century utilized the full potential of volley-firing technique. The infantries of Europe were transformed into body of professional soldiers – with long training and necessary discipline due to this change in military tactics.

The effectiveness of small firearms and cannon, though modest by modern standards, increased steadily. Riffling was introduced in 1520s, though it was not in general military use before the end of the 18th century. Hand-grenades were improved in 1536. The pistol was invented in Spain about 1540, and wheel-lock pistol in 1543. Cartridges were becoming more lethal. The bayonet, which seems to have been originated as a dagger at Bayonne in the 15th century, became when attached to a wooden haft and plugged into the muzzle of a musket, a common weapon in battle during the 17th century for hand-to-hand combat. By the 18th century the rifle, with flintlock fusil, lighter, simpler and more wieldy than a musket and with attached bayonet had become the standard battle weapon of an infantryman.

34.3.4 Reactions of the Traditional Warrior Class

The traditional warrior class of medieval Europe, trapped in the military ethos which accorded warrior status only to horsemen and accustomed to an infantry prepared to stand and fight with edged weapons, resisted the changes introduced by the gunpowder. They thought that only face-to-face combat was honourable and worthy of the descendents of armoured men-at-arms, fighting from horseback. Fighting from a distance with missiles and firearms, like the

crossbowmen, longbowmen and musketeers did, offered no scope for the individual feats of glory and courage. The mounted knights desired that such infantry men, who accompanied them to battle field, should take the manly risks of standing to receive opposing cavalry at point of pike. If guns had to take their place on the battle field, then let it be behind ramparts, which was where missile weapons had always belonged. The cavalry man did not want to dismount from his horse and learn the black art of gunpowder himself. A man armed with crossbow or handgun or musket, without any of the long apprenticeship to arms necessary to make a knight or even equally without the moral effect required of pike-wielding footman, could easily kill either of them without putting himself in danger. It appeared cowardly and treacherous to the nobility. The new military technology made the skill-at-arms of the knights; their strength and their honourable fight look worthless. But war is a serious business of destroying the ranks of enemy. Therefore, despite all the indignation and protests of the traditional feudal warrior class, it was evident by the mid-sixteenth century that firearms as well as cannons had come to stay. By the end of the 16th century, cavalry itself was losing its decisive purpose on the battlefield. Along with it the right of the knights to determine how armies should be ordered and the social-pre-eminence of feudal warrior class were also undermined. The French and German aristocracies resisted these changes, but changes in military techniques, tactics and strategy made their efforts futile. The centralised states also increasingly wanted value for money they spent on military endeavours. In England, Italy and Spain, the traditional military class was willing to learn the techniques of new arms and the technology of gun-powder and ready to persuade itself that to fight on foot might be equally honourable profession after all.

34.4 GUNPOWDER AT THE SEA

The early voyages of discovery by the Europeans (like of Dias, Columbus, Cabot) were not made by fighting ships. Such explorers went in small ships designed for coastal trade, with few arms, beyond the personal weapons of the ships' companies. Sea-fighting in the late medieval period was mainly a matter of boarding and entering the ships. The attacker sought to bring his ship into direct contact with the enemy, and to seize and hold fast with grappling hooks and lines, in such a position that his men could leap over into enemy's vessel and overpower resistance by hand-to-hand combat. From fighting tops like the mast—heads; the bowmen and hand gunners shot at the defenders, in order to keep them scattered and under cover. Sometimes fire was employed, but in most sea-fighting, the attacker's aim was to capture rather than destroy the enemy's ship.

The fighting galleys represented an extension and modification of these ideas. They were usually fitted with rams. A galley commander tried to catch the enemy broadside on, with the ram to cripple his motive power, the oars, and if possible to hole his hull. His men-at-arms, massed on the raised platform in the bows, would leap down into the enemy's waist. Sailing ships often co-operated with galleys in naval warfare, either as transports intended to land men for fighting ashore or as armed merchant auxiliaries, slightly modified for war and with soldiers on board, a body distinct from the sailors who worked the ship. It was probably the Venetians who initially introduced the ship-borne artillery in the fourteenth century. But by the middle of fifteenth century almost all European

fighting ships carried cannons. Artillery revolutionised sea-fighting. The transportation of heavy guns was a problems on land but cannon's weight could be easily accommodated in the ship while cannon-balls and powder could easily be housed in its cargo-carrying spaces. The only technical problem that encountered was that of absorbing its recoil within a vessel's confined dimensions. If mounted free, its firing would damage the ship's timbers. It had to be harnessed to the structure and it recoil decelerated by a breaking mechanism or else transferred to ship's own line of least résistance. The fighting ships of the 15th century carried forged cannons of small size only. The weapons of gun's barrel and the insecurity of detachable breech-block kept the guns small. However, in the 16th century, bigger cannons cast in a single piece, instead of forging from many pieces, from brass or gun-metals (an alloy of copper, tin and zinc) were built. This was made possible by changes in metallurgical techniques in Flanders and Germany and later in England. Similarly, breech-loading gave way to muzzle-loading in the sixteenth century guns. Although muzzle-loading of guns took more time and trouble, especially on ships, it was more then compensated by the increased strength which resulted from casting the guns in a single piece. It was the cast guns of sixteenth century, not the forged cannons of the earlier century that dramatically changed the design of naval fighting ships as well as the tactics of their employment. The design of ocean-going ships was adapted to fit big guns on them. Port-holes were provided for guns and turrets for gunners; the effectiveness of ship's broadside became the measure of her prowess. By the middle of 17th century, such a fighting ship could carry fifty guns a piece and a naval fleet of seventy or more ship emphasized the power of artillery on sea. The development of nautical gunnery not only made European ships more formidable; it also made ships' companies more homogeneous, and therefore, better suited to long voyages. Fighting ships or galleys in the fifteenth century and for much of the 16th century carried two distinct bodies of men: seamen or sailors under their own officers, who worked the sea; and the soldiers under their own officers, who did the fighting. The Captain was usually a soldier, though not necessarily a professional. He might be a gentleman adventurer. The master of sailors was a technical expert under the Captain's command, and his social inferior. The hostile rivalry at sea meant that ship will embark on voyage with a large body of soldiers, untrained to the sea. The possibility of divided opinions on a voyage in which most decisions would be nautical rather than military in nature, was highly dangerous. Heavy artillery on the ships necessitated that seamen understood both seamanship and gunnery. The lessons of homogeneous manning and a unified command, however, also gained acceptance gradually.

34.5 CHANGES IN THE MILITARY LOGISTICS

As the armies and navies grew in size and as soldiers and sailors continued for long terms in service due to creation of big standing armies by the European states, the military science of logistics (feeding, equipping, transporting and housing) emerged as a specialized branch. Fortresses and naval stations constituted not only homes for local soldiers and sailors but also supply centres for the troops deployed in the region. An elaborate institutional arrangement was needed to supply food, fodder and ammunitions to the troops. The constraints of land-transport and supply arrangements also obliged the armies to restrict their wars to certain well-defined border areas that were dotted with

fortresses, and early modern warfare was mostly a slow and cumbersome business consisting mainly of sieges.

Though warfare in the early modern Europe was still a restricted warfare in comparison to the great wars of last century, there is little doubt that the size of semi-permanent armies was increasing in the 15th and 17th centuries. According to one estimate, between 10 – 12 million Europeans became soldiers in the seventeenth century. The problems of recruitment, finance and supply for these troops had to be addressed by the European polities. The enlistment and recruitment of soldiers in itself was a problem of adequate supply of men for war. The early modern European armies were a mixture of mercenaries and volunteers. The volunteers had to be paid a 'bounty' or premium depending on the seasonal demand for agricultural labour and the current food prices. The mercenary and volunteer soldiers came from different social background and joined army for different motives but certainly hardship and want of livelihood were the most prominent motives. The professional mercenary soldiers were also in great demand but it had an inherent danger that they could change side at any moment and their loyalty could be suspect. The sovereign states, therefore, tried to enlist recruits from among their own subjects. Finland and Sweden were the first states who attempted to introduce some sort of compulsory military service or conscription in the early 17th century.

Many European states in the 16th and 17th centuries paid private contractors and entrepreneurs to supply military services which they could no longer afford to organise for themselves. By the end of the sixteenth century, several states had began to recruit and supply their armies – particularly units required to serve abroad – through private contractors. The system flourished during the Thirty Years War. The basic qualification of these military entrepreneurs was economic power and resources at their disposal. The army's rank and file also received considerable sustenance by other means – food and other supplies were secured from the civilian population and local communities through whom they passed. This "plunder", however, was systematized and controlled as a kind of "protection-money". In some cases, a kind of 'contribution-system' was worked out by local administrative authorities and army authorities. The system of contractors kept the armies fed, clothed and equipped but it had its defects. A few contractors were able to provide sufficient artillery from their own resources. For reasons of national security and exorbitant costs, most states deemed it necessary to create a stock of field and siege guns. The material supplied by contractors was also not always satisfactory. If arms and ammunition were not in perfect working condition, it could spell disaster for an army on the battlefield.

34.6 TRANSPORT AND NAVIGATION

The medieval Europe had inherited the legacy of Roman highways but it could not maintain it. Some of the ancient Roman roads served medieval man, not as means of communication but as quarries for neighbouring villages and towns. Nevertheless, those that were more frequently used were kept passable by constant attention to their surfaces, side drainage, and bridges. The road maps of the late medieval times provide proof that the arterial highways of the old Roman Empire were still in use. However, only few local roads of the medieval times were paved, Upkeep of roads, old or new, was responsibility of several

authorities. King's highways were properly maintained, not only for military purposes but also as routes to seaports and major markets. Important urban centres and markets also sometimes paved strategic roads with cobble stones or slabs, levying special taxes for the purpose. In England local parishes were supposed to maintain roads, but they did not have enough resources for this purpose. In France and other Continental countries some sort of forced labour or *corvee'* was resorted to as a means of maintaining roads. The step was not very successful.

Despite these weaknesses, the transport in the Western Europe was fairly well organised and a highly competitive business during the 14th, 15th and 16th centuries. Carts were in common use, although, pack-animals and even pack-humans (porters) were used occasionally for short local trips or over different terrains for carrying goods. For heavy long-distance haulage of goods, the two wheeled and four wheeled carts were standard means of transport. 'Cart-brokers' in large commercial centres put merchant in touch with carters' guild. Most trips, especially in the bandit-infested territory, were made in slow convoys, for security was precarious and policing almost unknown in the countryside. Occasionally, however, a special courier could make fast solo trip in case of urgency.

A major hindrance in the way of constructing new roads was the high costs. Expenses could be covered by charging toll charges on travellers, but such levies proved quite burdensome. When centralised administration emerged with the growth of absolutist monarchies, royal government also demonstrated good interest in an efficient centralised system of transport and communication. King Louis XI of France renovated main highways and in 1464 reinstituted a system of postal couriers. In the early sixteenth century, the Holy Roman Emperor granted Franz Von Taxis authority to organise a postal system for the Empire. The system of couriers, postal services and coach service expanded in the 17th century with the expanding intensity of circulation of goods. The London penny post (1680) was the cheapest of such services. France was developing technical expertise on road-building in the seventeenth century as is evident from several treatise on the subject. The practical results of such knowledge, however, became visible in 18th century only. The Tudor rulers of England also paid attention to the improvement of road-conditions. In 1555 Queen Mery appointed inspectors of roads. By 1663, however, a Turnpike Act in England permitted collections of tolls. After this, English roads became the enterprise of private turnpike companies operating under a government franchise. The improvement of highways also stimulated better construction of bridges over water ways. Despite these improvements and efforts by the States, land transportation remained slow and difficult. The horse remained the fastest means of transport on land in Europe until the 19th century, although oxen, mules, donkeys and reindeer were also used as draft animals. Horse-drawn wagons were usually uncomfortable. The cartwrights of Hungarian village Kocs devised a practical passenger vehicle, known in Hungarian as the **Kocsi** (French **Coche,** German **Kutsche** and English **Coach**). France, Germany and England gradually adopted this mode of conveyance in the 15th and 16th centuries. In 1634, over 3,400 coaches were operating on the English routes. Introduction of steel springs in coaches as a replacement for leather straps in 1670 made them more comfortable.

Water-transport was generally much cheaper mode than land in the early modern period. The timber shipped form the Scandinavian region used to cost less in English coastal regions than timber carted from the English hinterland. Until the fifteenth and sixteenth centuries most sea transport in Europe was coast-wise. River-traffic was more important to eastern Europe with its longer and slower-current rivers than to the Western Europe. Seafaring ships of the West were of two distinct types before the seventeenth century – the oared galley and the sailing ship. In the Mediterranean Sea, until about 1500 the galley with one bank of oars was the main vessel. Oars steadily increased in length, even to fifty feet. The steering oar gave way to the rudder, and man power was supplemented by masts and sails. The Venetians and the Genoese used huge galleys equipped with both oars and sails. Meanwhile the sailing vessels, with its stern-post rudder that permitted more effective steering, were being used on the Atlantic Sea. The Portuguese and the Spanish developed the caravel, a small, broad, lateen-sailed (triangular on long yard at angle of 45° to mast) vessel for ocean-travel. This was the type of ship used by Vasco de Gama and Columbus. By this time, rigging had improved. The navigators could beat-up the wind and achieve greater manoeuvrability on high-seas, with three-masted vessels (two masts square-rigged and one lateen-rigged). Such sea-sailing ships became common from 16th century onwards. Telescope was quickly adapted to navigation in the seventeenth century. These new navigational aids and better ships facilitated opening of new markets, trade in new commodities, consumption and commerce of larger quantity of older commodities and imports of precious metal from the New World. The aggregate effect of these changes resulted in what some historians call "the commercial revolution" of the sixteenth and seventeenth centuries.

The changes in shipping and commerce also stimulated the ship-building industry. In the seventeenth century, though the Dutch had to import their ship-building materials, they were perhaps the leading ship manufacturers and builders of marine carriers of Europe. At the end of the 16th century, the Dutch constructed the **Fluitschip** (The flute' in English), especially designed to carry the bulk-goods (such as wine, salt, grain and timber). It was of slender design, lighter weight, and shallow draft that was faster and cheaper to build and easier to run. There were also simultaneous improvements in the development and engineering of dock, maintenance of ports, construction of new light houses etc. Internal waterways, i.e. rivers and canals also played a significant role in transport. King's encouraged the construction of canals. The Languedoc Canal (1681) in France, 148 miles long with 119 locks, connecting Rhone and Garonne, was the engineering marvel of the age.

34.7   SUMMARY

The technologies of warfare underwent drastic changes in the early modern Europe, necessitating changes in military tactics and strategy as well. The use of gun powder by newly resurrected infantries (in the form of small firearms like hand guns, muskets and rifles) and by the big cannons of artillery and their applications on sea-going ships changed the nature of warfare as well as the institutional or organisational structures of the early modern armies in Europe. On the land, the effectiveness of infantries dealt a death below to the 'honour' and pride of feudal knights as the artilleries brought many old castles and forts to the ground. The European ships, fitted with big guns assumed naval

superiority and marked the beginning of domination of the world by the big European powers. All these changes were taking place under the watchful eye of absolutist monarchs, who adopted these changes in their new mercenary standing armies, to further enhance the power of states. This period also witnessed the increase in the circulation and exchanges of commodities on an unprecedented scale and a modest beginning was made to improve the transport and communication networks on land to match the requirements of new markets. However, the advances in sea-transport were more significant, again signalling the ascendancy of Europe.

34.8   EXERCISES

1) What was the significance of infantry in the military organisation of early modern Europe?

2) How did the Gun-Powder Revolution affect the design of forts?

3) In what way the use of guns on ships affected the conflicts at sea?

4) Compare the land-transport and sea-transport during 16th and 17th centuries.

5) How the military revolution of early modern times affected military logistics?

6) How did the traditional warrior class react to the use of hand guns.