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CHAPTER THREE

LAND TRANSPORT AND ROAD BUILDING

INTRODUCTION

Traffic on land was slower to develop than that on sea. This was partly due to the fact that the first urban centers arose in the Ancient Near East and the Indus valley, regions ordained by Nature for river transport. Early water transport also took away from the land those few goods traded over long distances and thus eliminated one of the most powerful incentives for an evolution of land transport. Prehistoric trade in Europe followed the big rivers as far as possible (fig. 32) (1). The Assyrian traders stationed in Asia Minor sent their goods down to the Euphrates or to the Tigris to be shipped home by water (2). The ancient Egyptian foreign trade with Crete, the Syrian coast and Somaliland or Araby was practically entirely coastal shipping to certain ports (3). Ancient Mesopotamian trade relied almost entirely on river transport (4).

Land traffic may hate and avoid the ascent and descent of hills and mountains, its real enemies are extreme cold and heat. Cold has made the extreme northern and southern regions of the earth sparsely populated, there roadbuilding becomes costly and uneconomic, generally speaking. The heat of the tropics and its deserts and dense jungles were formidable obstacles to ancient traffic until the advent of the railway, the motor-car and aviation.

Traffic and trade are related to a certain extent only. However, more powerful factors create long-distance communication and roadbuilding. A fanatical religion like Islam with its holy wars, its missionary urges and its pilgrimages promotes it. The rise of the early empires and their centralized organisations were based on quick information by letter and messenger. The mechanisation of armies which began with the introduction of the horse-drawn war chariot about 1500 B.C. demanded something better than a primitive track. A messenger service needed stations and rest-houses for men and beasts and supplies of water along the way at fairly regular intervals. The merchant followed the extension of power and his demands created a more stable and solid form of means of communication.
Upto that moment only human beings and messages made up traffic. Prehistoric trade is a barter from tribe to tribe. It never entails mass-produced goods but only such very valuable materials as precious metals and stones, pearls, amber, furs, silk, spices, salt and slaves. Later textiles and highly valued foodstuffs and other luxury goods were added. Even in classical antiquity such mass-produced goods like grain, olive-oil or wine took the way of the river and the sea, for every 100 miles of land transport doubled their price.

From the point of view of traffic the Mediterranean world was greatly privileged. Climate, situation and indentation are ideal for the evolution of long-distance communication (6). To the north of the bordering mountain-ranges there are the north-European, Russian and Asian plains with their gold, slaves, furs and corn, which appealed to ancient trade. To the south it was enclosed by the deserts of the Sahara, Nubia
and Arabia, which are broken by the Nile valley (and the rather un­navigable Red Sea), the gate to India and the East for the ancients. Though divided in three distinct zones by the peninsulas of Italy and Greece, it has four important gateways to regions beyond, Iberia, the Black Sea, Egypt and Syria. Mesopotamia and Persia with its second set of communications to India and the East belong to the Mediterranean world rather than to Asia.

Its mountain-ranges (generally east-west or northeast to southwest) have steep slopes, deep valleys lead into highlands poor in rain. The short rivers with strongly varying volume of water are hardly navigable and of little use to water-wheels generally. This is particularly true of North Africa and Asia Minor. Agriculture in the eastern part is dominated by irrigation, in the west “dry farming” dominates. The highlands were quickly denuded not only through human agency but mainly by the herds of goats held by the ancients.

In Antiquity the centre of this world, which was only united by the Roman Empire, moved from the east (Alexandria) to the west (Rome) and back to the east again (Baghdad) with the advent of Islam. But wherever its focus was, nature had shaped it for sea-traffic. Even the Romans, who were unwillingly drawn into naval warfare with Carthago in which they invented the corvus to suit their army tactics, dominated their empire by being masters of the Mediterranean. Hence land-traffic and its conspicuous result, road-building could only gradually gain ground by a series of strongly centralised political powers, the Persian Empire, the Hellenistic monarchies and the Roman Empire. In Roman times Western Europe had hardly more than 5—12 inhabitants per km² against 18—27 per km² in the Mediterranean world. Therefore even in Roman Europe the network of roads, dictated primarily by strategic considerations, was never as dense as in the south and the east, where over 50 million Roman subjects lived.

**LAND-TRAFFIC IN THE PERSIAN EMPIRE**

Long before the Persian king of kings started to develop a consistent traffic-policy tracks and bridle-paths had connected the settlements of men all over the world. In certain cases they had grown into systems like the ridge-ways and trackways of prehistoric Britain (7) which were levelled and traced to a certain extent and which converged on Salisbury Plain with its religious monuments such as Stonehenge, Woodhenge and Avebury. Hence they may not only have served a modest trade on
pack-animals but also may have been pilgrim-ways. In other parts of prehistoric Europe tracks had been constructed through swamps and marshes. These log-roads avoided great detours (8). In prehistoric Malta the strange artificial ruts cut into the rocky soil seem to have served to guide the carts loaded with earth and pulled inland by manpower to the terraces on the hillsides (9). Recent practical tests have proved that these ruts were not made for wheeled vehicles but for slidecarts, consisting of two wooden shafts supported at the front end by the draft animal (horse or ox), while the rear-end trails along the ground. The shafts widen towards the “heels” and the body of the “car” usually made of wickerwork hangs somewhere in the middle of the shafts. The ruts do not only lead from the valleys to the hills but some keep to the hills, others to the low grounds and hence they also seem to have been used for the transport of goods between settlements. The Egyptians had built causeways and roads from the quarries to the Nile for the transport of building materials. In Crete a track-system with guardhouses across the island from Gortyna to Knossos may date back to 2500 B.C. (10).

In the urban centers of the Near East attempts at road-building had been made for centuries and most of the main streets and market squares of Egyptian and Mesopotamian towns were paved with flagstones and slabs often brought down from the mountains at great cost. Some of these pavements are properly constructed on a brick foundation, the slabs being set in bitumen mortar, specially designed joints preventing the bitumen to sweat out and spoil the pavement in summer-time (11). Some of these paved streets are “processional roads” connecting temples in the city with the “festival-houses” (temples) outside the city-walls. On these roads carts carrying the statues of the gods were drawn between

![Fig. 33. Procession-road in the temple of Ishtar at Assur](image-url)
Fig. 34.
The main Persian highways
these temples on the occasion of religious festivals. The oldest proces-
cessional road was found at the capital of the Hittites, Hattusas, in
Asia Minor. It dates back to 1200 B.C. Next come a series of such
processional roads ("tallakti") in the Assyrian Empire at Assur (700
B.C.), Babylon (700 & 600 B.C.) and Uruk (300 B.C.). Some of these
pavements have artificial cartruts, the gauge of which coincides with
those of prehistoric Malta and Greece (gauge 138—144 cm). It seems
that the cart drawn by two oxen is responsible for this "standardisation".

However, this meant little for long-distance communication. Even
the great coastal road from Egypt to Gaza, Syria and Mesopotamia
was little more than a track, on which wheeled traffic was virtually
impossible because of the stepped ascents and descents (ladder-ways,
Gr. klimakes) in the defiles of the Nahr-el-Kelb and other places. The
Assyrian attempt at world domination meant a certain degree of mecha-
nisation of the army, which from now on had a siege-train. Already
Tiglath Pileser I (c. 1100 B.C.) had an engineers corps, the "ummani",
who laid pontoon bridges and levelled tracks for the carts and siege-
engines (13). He tells us about one of his campaigns in the mountains of
Elam: "I took my chariots and my warriors and through their weari-
some paths I hewed a way with pickaxes of bronze and I made passable
a road for the passage of my chariots and my troops." (14) More often,
however, his army met "a difficult terrain, where my chariots could not
pass", and the army would have to proceed on foot.

Neither did Sargon II, Sennacherib (c. 700 B.C.) and their successors
build a network of highways. Though no concentrated effort was
made there were certain attempts to establish regular communications
with distant parts of the empire. The Assyrians more or less regularised
the system of communicating by fire signals, an old system already
in use in Israel (15) and Mesopotamia (16). Now, during the hours of
the night "stacks of wood were fired and torches which shone at a
distance of a double hour (10.269 m)" (17). There was also some form
of messenger service for the kings, "men of the letters of the king"
served him in the empire, and centralised messenger-services were
at his disposal in the main towns. Maps of towns and town-quarters
and lists of towns and countries with their distances in "double-hours"
were at the disposal of these couriers. Some of these lists take the form
of the later Roman itineraries such as the list of towns from Assur to
the Persian Gulf and their distances (c. 800 B.C.) (18). We know that
the tracks in the Assyrian empire had roadsigns "which allowed travel-
lers to find their way after dark". On desert tracks there were "guard-
stations at regular distances and wells were sunk“ (19). Ferries (nābiru) made the crossing of large rivers possible in certain cases bridges (tilûru, gisru) were built such as the one at Babylon, over which classical authors waxed enthusiastic (20).

Though Sanherib remarks that “roads should be well kept and streets well constructed” and Essarhaddon in rebuilding states that it would be his policy “to open their roads throughout the land so that they can resume traffic with all neighbouring countries” this meant little more than levelling tracks and policing them. It did not improve on the speed of travelling since the news of the rise of the Nile at Elephantine reached to Memphis with a speed of about 11 km per hour (c. 2000 B.C.) or Hammurabi could write to an official at Larsa (200 km away): “Day and night you shall travel, so that you may arrive at Babylon within two days.” (21)

Though the Assyrians knew different types of four wheeled carts for the transport of building materials, a kind of covered waggon (for women?) and two-wheeled chariots none of these played an important part in land-traffic. Moreover the comparative study of ancient chariots and waggons is still in its infancy (21a). However, in this period falls an important change, the use of the horse as a riding animal. After the horse was introduced in the Ancient Near East (c. 2000 B.C.) from the North it had only served to draw war-chariots. Both in the Near East and the Far East (22) men had ridden on donkeys, but the donkey as a riding animal plays no part in the story of the road. Since the days of Sargon II, however horses were occasionally ridden, and his army had cavalry (710 B.C.), the earliest traces go back to the days of Assurnasirpal (c. 875 B.C.) In Egypt it was still a matter of surprise that a prince of Saïs rode on his charger and “asked not for his chariot” (c. 750 B.C.). Sometimes the later Assyrian kings send horsemen (ragab) as messengers to foreign countries (23). This art of riding horses came from the North and the East (Persia) and for the first few centuries it was still confined to nobility. Only much later did the horse affect the development of road-building, as few merchants used it.

The horse came into its own after Cyrus (550—530) founded the Persian empire, for the Persians were a horse-loving and horse-riding people. The Persian kings tried to get a firm grip on a subject by amalgamating them into one nation. A good stable currency for the whole empire was one of their means to achieve this and so was the messenger-service on which the classical authors inform us (24). This “arrangement was devised to meet the huge size of the empire and enable the king to
learn with great celerity the state of affairs at any distance. Cyrus first
ascertained how far a horse could travel in one day without being over-
ridden, and then he had a series of posting stations (stathmoi) built,
one day’s ride apart, with relays of horses and grooms (hodophylakes)
to take care of them, and a proper man is in charge of each station to
receive the dispatches and hand them on, take over the jaded horses and
men and furnish fresh ones. Sometimes we are told this post did not
even halt at night, the night messenger relieves the day messenger
and rides on.”

We are informed that the stations (hippones, stathmoi) were some
25 km apart (25). They also housed troops and seem to have played
some part in a system of fire-signals (26), which the Persians also used
in their wars against the Greeks (27). The perfection of this messenger-
service (angarelon) is laid to Darius I (521—485), echoes of it can be
found in the Old Testament mentioning “posts on horseback, and riders
on mules, camels and young dromedaries” (28). It was a Royal postal-
service and its command was held a great honour. In fact Artaxerxes
entrusted Codomannus (the later Darius III) with it (29).

This track-system led to the palaces of the Persian kings at Susa,
Persepolis and Ecbatana. Its main track, which Herodorus calls the
Royal Road, leads from Sardis (the most western provincial capital)
and the harbour Ephesus to Susa via Issus, Laodicea, the Cilician Gates,
Tarsus, Zeugma, Nisibin and Niniveh. (30) This stretch of 2600 km
was covered by messengers in nine days, ten times as quick as an army.
The distance between Babylon and Susa was covered in 1½ days, that is
an average of 150 km a day. It should be realised that this is a speed
attained by specially equipped messengers but it certainly was not
beaten until well after Napoleon’s days.

This trackway-system was no attempt at large-scale roadbuilding.
We do hear of two paved highways between Susa and Ecbatana (31).
But Diodorus tells us at the same time that stretches of the Royal
Road were difficult because of the many steep slopes but still practicable
for carriages and Xenophon in his story of the retreat of the 10,000
Greeks has only too many stories of beaten paths and chariots stuck
in the mud (32). In fact the tracks were simply cleared and kept in repair
by the ancient simple means described in a report of an address of Cyrus
the Younger to his army (33): “You gentlemen, who are in command of
the roadmakers, you have the lists of soldiers I have disqualified from
serving as javelin-men, bowmen or slingers, and you will make the
old javelin-men march with the axes for falling timber, the bowmen
with mattocks and the slingers with shovels. They will advance by squads in front of the waggons so that if there is any roadmaking to be done, you may get at work at once, and in case of need, I may know where to get the men I want.” Roadbuilding here simply meant levelling a track, and that was its meaning in the East until well in the Roman times.

Apart from perfecting postal services the Persians were also responsible for the general introduction of the dromedary and the camel as a riding animal and a beast of burden (34). The camel was domesticated in Central Asia in late neolithic times, at the same time the dromedary was tamed and bred in Arabia. The Egyptians by their contacts with the desert-dwellers knew the dromedary from pre-dynastic times onwards and so did the Jews from the time of the patriarchs. About 1100 B.C. the camel was introduced from Media by the Assyrians for mountain traffic; they adopted the dromedary for desert travel about 700 B.C. The basis of the ancient southern Arabian kingdoms was camel-breeding. The true camel, an animal of temperate zones, though introduced there about 1100 B.C., was never a success in Arabia. The dromedary, however, became the most important means of desert transport until the advent of the motor-car in our era.

The rise of camel-transport as a more international form of traffic began in the Syrian desert (35). Its rise became possible when the two horns of the Fertile Crescent were held by one political power or at least two friendly interdependent ones willing to take the short cut through the desert for trade’s sake. Also the Arabs should by then be sufficiently advanced in camel-breeding to have sufficient riding- and pack-animals available to trade such specific agricultural or coastal products as salt, on which trade Palmyra was to grow rich. It was important that routes be traced with a perennial water-supply from springs or wells, no toll-barriers, the chronic threat of desert robbers firm in hand. As a matter of fact the early Arab tribes had their intertribal wars and supplied warrior-bands to their allies in the fertile Crescent but left the traders of Syria and Mesopotamia alone in the earlier centuries of desert trade. Desert robbers are first mentioned in the third century A.D. (36).

The above conditions were first fulfilled in Persian times. Tadmor may appear in inscriptions of Tiglath Pileser I, but the first traceable desert tracks date of the Persian period. The keys to this trans-desert traffic between Egypt and Syria on the one hand and Mesopotamia on the other hand are Palmyra and Petra, but their rise is due to dif-
ferent political causes. Palmyra flourished in the Persian period but it suffered a decline in the Hellenistic period when the direct route from Syria to southern Mesopotamia was deserted until well in the second century B.C. Then Palmyra grew in importance again, especially when the Romans and Parthians came to a mutual and advantageous understanding about the importance of desert trade on the eve of the first century A.D. These desert roads were retraced from the air and this is not the only field where air archaeology has proved invaluable for retracing the ancient network of roads and tracks (37). The Romans developed a series of highways throughout Palestine, Syria and Transjordania well-marked with milestones as “feeders” of these desert routes, which remained unpaved but well-marked and supplied with wells or cisterns every 30 miles (38).

Palmyrene trade reached its apex when Petra declined and Armenia became a battlefield between Romans and Parthians. Its decline came with its fall in 271 A.D. but there was a short revival after the reign of Justinian VI until the early Muslim period. The revival in the eighth century lasted some 500 years but dropped off sharply after the sack of Baghdad (1258) and ended with the fall of Constantinople (1453).

Petra first became important in the Persian period and its prosperity rose with the rivalry of the Ptolemies and the Seleucids (second century B.C.) which tended to diverge all trade with S. Arabia to Damascus and Syria instead to Egypt where the Ptolemies tried to draw it. Pompey’s conquest of Syria awakened Petra’s interest in the Palmyra road which interest was maintained until the reign of Trajan. Early in the Christian era Bosra began to take over Petra’s role as the “desert port” of Arabia Felix and Petra declined. The Persians may therefore well claim the honour of having initiated a new form of traffic, dromedary transport through the desert, which ever since was important in the connections of the Mediterranean world and Europe with the Far East and with Africa where the camel was introduced in Roman times.

Traffic in the Greek World

The coast of the Greek homeland was strongly indentated and nearly every Greek town could smell the tang of the sea. “The Hellenes engaged together in no enterprise before the Trojan war on account of weakness and lack of intercourse. And they were united only when they were making considerable use of the sea.” (39) Even “those who dwell more in the interior and away from any trade route” (40) sought
the shortest route to the sea. Even in Strabo’s days the roads of Greece were generally bad and hardly ever drained (41). This frustrated development of roads was partly due to the fact that mountain-ranges up to 3000—5000’ cut the country up into sharply divided valleys. More important still was the lack of political unity which persisted up to Roman times. When Aristotle wants to describe the political structure of Greece he has to review the laws of some 150 city states or poleis. This lack of a strong central power may well be the reason for the bad road-system. When unity was finally enforced by foreign domination, Greece was no longer an important factor in the economy of the ancient world and none of the great Roman highways touched the Greek homeland.

We have little direct information on Greek road-building (42) but we are sure that it was not due to Phoenician influence, formerly much overestimated. The Mycenean civilisation of Greece, heir to the older Minoan traditions had indeed constructed some “cyclopean” roads in the region of Argolis and Mycenae. These roads have a pavement of polygonal slabs, well-drained foundations and several bridges (43). These may represent the “well-drained roads” mentioned in by Homer (44) for we hardly find any well-built road in Greece before Roman times. This is clear from many passages in Pausanias’ description of Greece (150 A.D.) where many roads are proclaimed to “grow steeper and more difficult to man on foot,” “a mere footpath”, “easier for men than for mules” and “impassible for carriages by reason of its narrowness” (45). Only in a few cases they are “suitable for carriages”. On the very important route-from Megara to Corinth he says “it was first, they say, made possible for footpassengers by (the mythical) Sciron, when he was war-minister of Megara; but the emperor Hadrian made it so wide and convenient, that even chariots could meet on it.”

In fact most Greek roads were hardly more than footpaths or bridle-paths, mostly hardly suitable for pack-animals, as steep slopes were taken by steps cut into the rocks (klimakes, basmides). Carriages existed but were unpopular. Their use was considered effeminate and even forbidden in certain cases, such as processions from Athens to Eleusis. A kind of covered waggon (kanadron) was used almost exclusively by women and priestesses. Carts (hamaxa) were used in certain localities for the transport of grain, marble, and the like if the roads permitted it. In a few cases special roads were built for such purposes from the mines and quarries to the coast (45a). There was one to the quarries of
the famous Pentelic marble in Attica, well-paved with slabs, and with holes along the side which probably held poles to prevent the sledges or carts with quarried marble from sliding from this regularly sloping road. However, such roads built for special purposes can not be quoted as proofs that the ancient Greek roads formed a good means of promoting land-transport and even the much better Roman road-system never invited a really important road traffic or long-distance haulage of goods important in everyday life such as cereals and the like. There was a limited land-transport for luxury goods, but generally speaking the rule held, that larger quantities of heavy goods were transported as quickly as possibly to the nearest navigable point of a river or to the coast. Another one with artificial wheelruts led from the white marble quarries of Agrilesa to Kamaresa.

Road signs were formed by piles of stones. Hesychius, commenting on these roadmarks tells us that Mercury after killing Argus had to throw an “absolution stone” on the roadside. This custom of throwing a stone on a pile at certain points of the road after saying a prayer still exists in many countries. In historical times square stone pillars with one or more busts of Hermes, god of the travellers, and called “hermae” were erected at such spots. The Greeks seldom resorted to the planting of trees along their roads. Pausanias mentions only the roads along the Isthmus which ran between “rows of pinetrees most of them shooting straight up into the air “and that along the Alpheus near Herea” planted with myrtles and other trees” (46). However there was a general sprinkling of resthouses and inns along these tracks for “roads without inns are no better than life without holidays’ (47).

Road building was therefore seldom considered a serious task of the state, though in Sparta the two kings “were to judge in all matters concerning highways” (48) and Peisistratos of Athens made a traffic law for Attica and had the roads measured and repaired (550 B.C.). These special surveyors, called bematistai, mapped the roads from a central point, e.g. the agora (market place) of Athens (49). Actual road building was even in disrepute for “Epaminondas (of Thebes) undertook the survey and inspection of all roads which the citizen who disliked him had entrusted to his care to insult him for this work was in discredit. However by his excellent administration he made many Thebans compete for this job as a high honour” (50).

However, there was one exception, the sacred road. This pavement with artificial wheelruts already attracted the attention of early travellers in Greece. “The term rut must not be understood in the sense of a
hole or inequality worn by long use and neglect in a level road, but of a groove or channel purposely scooped out at distances adapted to the ordinary span of a carriage, for the purpose of steadying and directing the course of the wheels and lightening the weight of the draught on rocky or precipituous ground in the same way as the socket of our railroads. Some of these tracts or stone railways, for such they may in fact be called, are in a good state of preservation, chiefly when excavated in strata of solid rock.” (51)

These sacred roads connect a city with a sanctuary and they usually represent the journey of a god on earth. Such roads as that from Athens to Eleusis, Sparta to Amyklai or Elis to Olympia were used for pilgrimages and religious festivals. Others lead to the famous oracle of Delphi.

The ruts were carefully hewn, polished and levelled so as to form a perfectly smooth and easy track for the cart wheels. The levelling instrument used was probably the dioptre. The Greeks considered the rut (ogmos) the real road and sometimes left the rest of the road surface unpaved. When these wheelruts were used by ordinary traffic difficulties might be expected if there was only one pair of wheelruts. One was lucky if one could say with Ion: “I seldom was molested, from my track no villain drove me.” (52) In case of two chariots meeting each other, one had to give way, leaving the ruts to stand aside. This might become a reason for a violent quarrel like the one in which Oedipus killed his father, unknown to him, on the Cleft Way to Delphi (53). Some of these roads have points (ektropai) built in at certain distances.

The gauge of these ruts (usually 7—10 cm deep and 20—22 cm wide) was 138—144 cm like those of Maltese and Etruscan roads, though no connection has been traced between these systems. A few ordinary roads had such ruts too, sometimes even double tracks like that from Athens to Delphi, Sparta and Elis and Athens to Pyrgos. In the latter case a low wall crosses these tracks, it may have been a toll-barrier where the goods were transferred. Some of the sacred roads were entrusted to religious authorities such as the Amphictyones, the board of the Delphi oracle whose law of 380-379 B.C. says: “...and the bridges the Amphictyones shall repair, each his own part, and they shall see to it that they are not damaged, and the ambassadors of the Amphictyones shall look after the roads, whatever is needed for them, and they shall punish (those who damage their roads).” (54)

Ancient Greece never had anything like the Persian postal service. The Greeks used fire signals occasionally (55) and most cities had two
or more fast-sailing ships (56) for quick long-distance communication. Some cities also had special messengers or runners (hemerothromoi, dromokerykes) which in time of war served as spies. Merchants had slaves which they used as runners.

A factor in this story of Greek roadbuilding was the gradual deforestation of the homeland. In the days of the Persian wars “the stay of Xerxes in Pieria lasted for several days during which a third part of the army was employed in cutting down the woods on the Macedonian mountain range to afford his forces a free passage into Perrhaebia.” (57) When Macedonian power grew and its armies had an engineering corps with Thracian road-engineers (58) and a siege-train, it became necessary “to build fortresses and cut straight roads for military purposes” (59). The Greek armies now had their war-engines and became convinced of the necessity of good roads when they marched into Asia with Alexander. With the Persian tracksystem Alexander’s army could make an average of 30—33 km a day but on certain occasions even marched 74 km. This meant that even when the central power of the king of kings declined the satrap or local governors kept the roads in good repair.

Even when Alexander’s empire was cut up into four major Hellenistic monarchies this lesson was well remembered and the Persian postal service maintained notably in Egypt. The Zenon and Hibeh papyri (60) confirm this statement of classical authors (61). It was definitely a state-service (62) headed by officials called cleruchs. The land-mail service included a series of stations headed by a horographos where horses are cared for and messengers could rest. Apart from this there was a river-mail service. The land service ran two routes east and west of the Nile and sometimes took private letters. Apart from this there was a service of camelriders (camelites) and one of runners. The service was financed by taxes levied. This “liturgy” sometimes took the form of exaction of animals and fodder from the local population or requisitioning of houses. Later the right of the official to requisition was reduced and certain classes of priests exempted from this tax.

There never was any appreciable road-travel in Hellenistic or Roman Egypt, though a time-table of the camel-post was found (63). The ease with which passengers and goods could move up and down the river made roads superfluous. The camel, now universally used for landtransport was antagonistic to paved roads. Nor were any large bodies of troops stationed in Egypt, and a military road-system was never developed. However a road-system was developed and im-
proved in Hellenistic times, that of the Nile to the Red Sea which was so important for Alexandria’s trade with Arabia, India and the Far East. Traffic sailed up the Nile to Coptos and then struck eastward to the coast of the Red Sea of old (64). The oldest road led straight to Koseir (Albus Portus) where the ships could then be loaded, thus avoiding the long and dangerous passage through the gulf of Suez. Later more northern ports like Myos Hormos and Kenah (Kainopolis) were used, though the Roman traffic often struck south along the coast at Koseir to reach the port of Berenice. These roads were in reality all tracks but fortified watering stations (hydreumata) were provided along the route. These were hostels with substantial rubble-walls and flanking towers at the angles and at either side of the gateway. In the centre was an open space for the animals and a well. Most had brick reservoirs lined with cement for storing water. The Coptos-Koseir road was further marked out by a system of intervisible beacons or signal towers.

In the other Hellenistic monarchies the ancient systems were kept more or less in repair and changed little until Roman times. The old Persian roads of Asia Minor (65) still ended in the few available western harbours. The harbour of Miletus got silted up first, Ephesus followed in the Middle Ages. In the meantime, however, traffic became centered on Byzantium and the main routes now cut the province diagonally. Even under Turkish rule the postal service was still maintained.

**Evolution of the Roman Roads**

What failed to be achieved by the Greeks was realized by the Romans who inherited from them the complex of ideas belonging to the maintenance of city life. The city (polis) came to be characteristic for the form of group-selfexpression of the Western Mediterranean and it was supplemented by the legists and civil engineers of Rome. With the stubbornness and tenacity of the peasant, which they always remained at heart, the Romans achieved an excellent land-transport system (66).

When BERGIER wrote the first modern handbook on road-building in 1622 (67) he believed that the Phoenicians and Carthaginians had instructed the Romans in this art. This opinion based on passages from later encyclopedists (68) have been repeated frequently (69). ISIDORUS tells us: “A street (strata) is so called because it is worn by the feet of the public.” LUCRETIUS says: “And the streets of the roads already worn smooth by the feet of the public.” The same “strata” also means “laid down”, that is spread with stones. Now the Carthaginians are said to
have been the first to pave the roads with stones; afterwards the Romans laid them out over almost the whole, for "directness of journeys and to prevent the populace being workless". But not being a roadengineer he confuses embankment, pavement and other elements of roads and then introduces startlingly modern theories about road-policy, which have proved all wrong.

It is true that the Carthaginians paved their streets and made a few tracks and embankments (70) but the true impulse came from Italian soil. The Romans learnt their townplanning from their Iron Age ancestors of the Po valley, whose settlements contain log roads and other primitive forms of pavements (71). The Etruscans taught them the art of engineering, drainage and road-building (72). Though some have discussed and even depicted very sophisticated types of "Etruscan" roads (73), it now seems quite clear that most of them are just well-drained tracks on which the later Roman roads were built (such as the V. Aurelia, V. Clodia and V. Cassia) (74). Some of these roads must have been well passable for carriages, like the one on which the Vestal Virgins travelled from Rome to Caere when the Gauls invaded Italy (75). Some of these roads had artificial wheelruts and shunts like the Etruscan limestone paving slabs discovered at Fiesole, Perugia and Graviscae (76). They had also invented the slabs with a series of grooves, called "cordonato" by the modern Italian, which anti-slip pavement they lay in steep streets (e.g. at Fiesole). Finally the Romans used the extensive knowledge of building materials of the Greeks and adapted their lime-mortar and their "macadam" city-pavement (lithostratos). These three elements the Roman engineers welded into an excellent art of their own.

The Romans therefore inherited a system of tracks such as the later Via Gabina, Via Latina and those already mentioned (77). The most important of these was the Via Salaria which carried the prehistoric salt trade from the sea coast to the Sabine highlands (78). It was first paved as far as Reate, but Augustus paved it as far as Truentum on the Adriatic. Also there were cattledrifts like those from the meadows of Samnium to the Apulian lowlands. Most of these tracks disappeared in the course of history, being used as a foundation for later roads. Thus the Via Appia partly covered the old gravel road (V. Norbana) from Velitrae-Cora to Norba.

The need for better roads arose from the expansion of Rome about 500 B.C. Conquest and colonisation want hand in hand. The new colonies of Roman citizens, often rebuilt older towns, and the re-
conciliation policy extending the rights of citizenship (partly or wholly) to the conquered, who were of Latin stock, formed strong bonds which held in the Gallic invasion and the Samnite wars. The founding of Velitrae (494 B.C.) and Antium (467 B.C.) started a movement lasting until the days of Caesar. The roads were gradually gravelled, then paved.

In this earlier phase these roads were not primarily strategic. They served traffic and communication, they followed the conquest but only many years after the region was pacified and safe. Thus ten years elapse between the fundation of Placentia and Cremona and the building of the Via Aemilia. Only in later phases do we find such definitely military roads as those along the “Limes” of Germany and Syria. Other factors besides colonisation hastened rebuilding of the tracks. The growing cultivated area and the growth of landed property now shut in the old undefined track.

Fig. 35.
Growth of the road-system of Roman Italy
Technical improvements like the introduction of lime mortar from the Greek cities in southern Italy (300 B.C.) and the natural cement called “puzzolano” (150 B.C.) hastened this process. The flagstone pavement could now be made watertight and rested on a solid foundation. The first of the great highways, the Via Appia, from Rome to Capua was paved by the blind censor Appius Claudius (312 B.C.) in order to bring the Campania and its harvests within reach of the old city. It began as a gravelled road but after the Samnite wars the section to Bovilae (296—293 B.C.) was paved with the “fines levied on cattle breeders” (79). In 289 B.C. the oldest stretch was widened and two sidewalks were constructed. Shortly after the invasion of Pyrrhus the Via Appia was gradually extended to Brundisium and Tarentum.

Shortly after the Gallic invasion Gaius Flaminius divided up the “ager gallicus” and hence the Via Flaminia had to be extended beyond Spoleto to Fanum Fortunae (220 B.C.). The twenty years at the end of this century, because of the Second Punic War, show a lull in the progress. Then the defeat of Hannibal inaugurated a period of vigorous expansion. The valley was conquered and the colonisation of Bologna and Aquilea meant the building of the Via Aemilia. Around 175 B.C. the V. Aurelia and V. Cassia followed, financed by the Carthaginian war indemnity. The Via Postuma followed and the west coast road from Aquilea to Brundisium. At the same time the streets of Rome were paved and “the roads outside Rome were covered with gravel and footpaths raised at the sides.” (80).

Then the three Macedonian Wars gave the Balkan Peninsula to Rome. In 148—145 B.C. on the farther coast of the Adriatic opposite Brundisium an extension of the V. Appia, the V. Egnetia, was built reaching from Dyrrhachium to Thessalonica and later beyond to the Hebrus (81). It was later connected with the new Greek highways constructed under the Empire. Nero built the road from Byzantium to Thrace, Trajan and Hadrian paved roads along the west coast of the Black Sea to Tomi (82).

The Civil Wars inaugurated another period of slackness. Still G. Gracchus succeeded in getting his \textit{Lex Sempronia viaria} adopted (123 B.C.). It ordered the extension of the Italian roadsystem, with more attention to be devoted to drainage and foundation problems, and also increased the number of milestones. In the meantime the occupation of most of Asia Minor led to a repair of the existing Hellenistic system by M. Aequilius (129 B.C.). In the Gracchian period puzzolano, a natural volcanic trass found near Puteoli, was discovered. It promoted
the application of concrete constructions on a much larger scale. The consul Marius extended the road along Italy's west coast (V. Aemilia Scaurus) from Luna to Genoa, which together with new roads in the Po valley now connected Italy through southern Gaul with the new roads in Spain from Gades (Cadix) through Numantia to the Pyrenees. The link from the mouths of the Rhône (Arles) to Genoa ran over the Mont Genevre (Alpes Cottiae), only during Augustus' reign was the present Riviera road (V. Julia Augusta) was built (13 B.C.).

Caesar's Gallic Wars started organised roadbuilding in Gaul. Before the Roman Conquest there were many native tracks but the great highways belong to the Empire. Their natural centre was Lugdunum (Lyons), whence a road south along the Rhône led to Arles and the coastal roads. A western road running through the country of the Averni reached the mouth of the Loire and then struck south to the present Bordeaux. A road to the north-west reached the coast opposite Britain, the north-eastern road led to the valley of the Rhine and Germania. These large roads formed the backbone of an intricate web
of roads built by Claudius, Trajan, Nerva and Vespasian. Trajan connected this system with the roads leading through Germany to the Danube and the Black Sea.

Already in Republican days two roads penetrated the newly-won territory of Spain. However Augustus laid out a proper road-system comparable to Agrippa's plans for Gaul. He surrounded Spain with a great circle of roads with one or two branches penetrating to the inland mining districts of Rio Tinto, Almaden and the Sierra Morena. One of the chief functions of these roads was conveying the ores and metals to the seaports for shipping to Rome. The frequency of relaying roads points to intensive traffic and the determination to exploit the resources of the district. Older tracks were rebuilt into important trade-routes which were kept in good repair as is evident from van Sickel's (83) data compiled in Table I.

Claudius' occupation of Britain resulted in the building of durable commercial highways, partly trackways rebuilt. London remained the centre whence trade went to the Channel ports. Military roads were built in Wales and the Lake District as well as along the Wall. No milestones earlier than Hadrian survived, during whose reign the roads along the north Welsh coast were taken in hand (83a).

Africa, one of the granaries of Rome, was completely pacified by Augustus, who founded colonies, constructed roads and provided the province with police forces. Then whole triangle Carthage-Cirta-Tacape needed good communications between the agricultural districts and the seaports and roads for the patrols of the military police (84). More to the west there were towns belonging to Spain rather than to Africa for the traffic went mainly by sea as there seems to have been a break in the road-system along the coast.

In Syria and Palestine the old roads were gradually paved (84a) and provided with hill forts along the desert against brigandage. This gradual construction of well-built roads started by Herod and his family was crowned when Trajan annexed Arabia Petrae (Transjordan) and built a splendid system of roads with a line of watchtowers and posts. The roads of Syria and Judea were carefully paved and garrisoned, the road from Antioch to the East constantly repaired and in northern Syria miles of roads of black basalt were built which have survived almost intact. The trade from Arabia to the north was sheltered by the Strata Diocletiana during the rise of the Sassanian Empire which military road was well-equipped with forts, water-supply from wells (85) and camps for the Bedouin auxiliaries.
In Asia Minor a consistent road-system was only possible after the Romans give up the system of buffer-states between themselves and the Parthians. Thus its roads were mainly built by the Flavians, Vespasian, Titus, Nerva and Hadrian. Here again we find many military roads on the protected border, the "Limes", which system the Flavians also adopted on the Rhine and Danube frontier. The road-system on the Rhine was begun between 73 and 84 A.D. but the "limes germanicus" was not completed until the reign of Trajan. The log-roads built by Caecina and Domitus from the Rhine eastwards into the territory of the German tribes were also military roads to combat the danger of raiding tribesmen. Thus, at the zenith of its power, the Roman Empire disposed of a 90,000 km system of paved highways, 14,000 km of which were located in Italy proper. If we include the secondary, tertiary and gravelled roads we obtain a total of 300,000 km. Twenty-three highways radiated from the capital, Rome, and led to the confines of the Empire. The topography of these roads has been studied in great detail (86) and new finds constantly increase the total mentioned above.

**Roman materials and road-constructions**

Unfortunately we possess no Hellenistic or Roman handbooks on road building. Even Vitruvius (87) is rather vague on the paving of streets though he is more explicit on floors which were composed of four strata, as confirmed by excavations. Vitruv’s instructions are: “If we must lay our floor (ruderatio) on level ground, we must inquire whether the soil is solid throughout; it is then to be levelled and upon it the foundation (statumen) carrying another layer (rudus) shall be laid. But if it is a made site, in whole or in part, it must be very carefully rammed with piles.” After discussing the building of upper floors and the planks to be used he continues: “Next a layer of stones (statumen) will be laid each of which at least fist-size. When the statumen has been laid the rudus, a mixture of hard core and lime, shall cover it. If fresh bricks are broken up for use, one should use three parts on one part of lime; if it is of old materials, five parts of rubble are to be mixed with two of lime. Let it then be laid on, and rammed down with repeated blows by gangs (decuriae) of men using wooden stamps. When the stamping is finished it must be not less than nine inches thick.

Upon this, a nucleus of powdered pottery is to be laid, three parts to one of lime, forming a layer of six inches. On the finishing coat, a pavimentum is to be laid to rule and level.”
Excavations have proved that roads too consist of four different layers (statumen, rudus, nucleus and pavimentum or summum dor­sum). The statumen can be compared with our handlaid foundation, the rudus is a watertight layer shutting out the damp from the statumen. Thus statumen + rudus together form the foundation proper. The nucleus is perhaps intended to serve as a “binder” for the pavement. The Roman authors (89) and poets have little say about roadbuilding except Statius, the poet-laureate of the emperor Domitian, who describes the building of the Via Domitiana (90 A.D.) in these words (90):

“Now the first stage of the work was to dig ditches and to run a trench in the soil between them. Then this empty ditch was filled up with the foundation courses and a watertight layer or binder and a foundation was prepared to carry the pavement. For the surface should not vibrate, otherwise the base is unreliable or the bed in which the stones are rammed is too loose. Finally the pavement should be fastened by pointed blocks and held at regular distances by wedges. Many hands work outside the road itself. Here trees are cut down and the slopes of hills are bared; there the pickaxe levels the rock or creates a log from a tree; there clamps are driven into the rocks and walls are woven from slaked lime and grey tufa. Hand-driven pumps drain the pools formed by underground water and brooks are turned from their courses.”

However, the Roman road-engineer never stuck rigidly to this four-layer scheme. He shows great skill in varying it to local conditions, in using local materials and constructions to achieve his goal and he was never dogmatic to his own disconforture. The type of construction was adapted to the type of traffic. It will be clear that a “transport road” like the one constructed by Hadrian for the transport of Numidian marble from the quarries at Simithus to the harbour of Thabrace will differ from the simple country track. Such tracks or “viae vicinales”, just levelled, rolled and drained, existed along many superior types of roads. We know little about the Roman gravel roads because most of them have disappeared by now. However in the days of Palladio (1518—1580), famous architect of the Italian Renaissance, methods were still in use reputed to be Roman practice (91). Probably all secondary roads (viae vicinales) were at least gravelled. The course of the road was levelled, sometimes rammed or even rolled with wooden or stone rollers (92), then an embankment of sand with a gravelled surface or a gravel layer was laid. Stones from the neighbouring fields served as curbstones. On both sides there were ditches down to 6′—8′ below the road surface.
Paving the road surface meant limiting the width. Thus the 120'-100' old track gradually became the 40' metalled road surface as decreed by Augustus for great highways (viae munitae). The delimited road, the “agger publicus” was state property. The shoulders, often 6-9 m wide, enclose the “actus” or carriage road and its sidewalks (iter) for foot passengers, which were often separated by a low stone wall (umbo) or a strip of grass. Gravel roads of this type survived in France under the name of “chaussées de Brunhaut” or “chaussées en accôtements”.

The Romans also used cobble roads, laying the cobbles in a 10 cm sand-bed. Most cobble-surfaces survived in city pavements. A primitive macadam road-type was imported from Greece. Like this “lithostrotos” the Roman macadam road was made by spreading chips, taken from the stone quarries, on the subsoil and ramming or rolling (ingenti cylindro) them to compaction. Repairs consisted of a fresh layer of chips rammed into the original surface.

As soon as lime and puzzolano were known mortars for grouting and concrete mixes could be used. Pavement slabs were usually cut from lava (silex) or tufa, hence the term “silicarii” for paviours. A green variant (cappellaccio) of tufa, was very popular and so was peperino, a conglomerate of volcanic ash and gravel. Bricks (testae) or tiles (tegulae) were also used, pounded tiles forming the main ingredient of the concrete (caementum) used. Even forge cinders or slags were used to surface the so-called “viae ferrae” many examples of which were found in Britain (92).

Lime mortars were used to grout the joints of paving slabs and also gravel layers. The varying qualities of different sands were early realised. Vitruvius proposes the following sand-lime ratios for river
sand, down sand and quarry sand: 2-1; 2-1 and 3-1. If gravel (glarea), chips or crushed bricks were added to the mortar (usually three to one) the common concrete (caementum) was obtained. For road-building a gravel concrete was very popular with a mortar consisting of one part of lime, three parts of puzzolano and $2\frac{3}{4}$ to $3\frac{1}{2}$ parts of sand. This strong hydraulic mortar compares very favourably with modern portland cement mortars. As during the Empire other deposits of trass, besides Puteoli, were found and exploited, e.g. in the Eifel district.

The usual type of main highway consisted of a 20—30 cm statumen of hand-laid slabs, a 30—50 cm rudus of grouted cobbles or crushed stones, a 30—50 cm nucleus of rich gravel concrete and a 20—30 cm pavimentum of 30—100 cm square stone slabs or a rich trass-concrete with aggregate upto 6 cm. This total depth of 100—140 cm is some 3—4 times that of a modern roadcarpet and hence the Roman roads have aptly been called "walls on the flat" (93). Even with the relatively small traffic (though dense locally) they stood up to the wear of iron-tyred wheels and hoofs of unshod animals for 70—100 years before they needed thorough reconstruction as shown by the data from Spain, though on more frequented stretches a 30—40 years' service is more probably. We have few figures on the extent of traffic and the frequency and costs of repairs. Though the Romans used perfectly sound building methods their invention of concrete halted the development of more plastic road carpets like cobble and macadam roads. Their rollers were not heavy enough for compaction of such roads. The care for drainage of the foundation was excellent and thus saved the rigid thick concrete mass from breaking up by frost or water. The pavement had no expansion joint and thus was little suited to climates of extreme temperature changes. The use of local materials meant dissimilar materials in different stretches of the road subjected to the same hammering action of hoofs and tyres.

In the northern parts of the Empire cracks and potholes formed more easily and thus in the later Empire constant repair took the over-hand over construction of new roads. The cobble and macadam roads probably had a life of 10—15 years. There were of course many variants of the common constructions mentioned here (95) but the above figures give averages obtained by the comparison of ancient and modern roads (96). The width of a 40' carriage road plus side-walks and shoulders is about 80', the other roads have 12'—16' paved surface on a total width of 36'—40'. On some military roads the side-walks were used by carts, the main road being used by the marching legions. The ditches
(sulci) were usually 10′ wide and as deep as the foundation course, though often they go 10′ deep. The usual camber is 1:20. Milestones, the invention of which was ascribed to G. Gracchus (97), were of course much older. The Roman milestones, the oldest of which go back to about 250 A.D. have made the study of the Roman highway system much easier (98).

Disposing of efficient surveyors’ instruments the Romans could set out (99) their roads perfectly straight as far as natural conditions would permit. CODRINGTON found that in Britain they seldom deviated more than half a mile on 20—30 mile stretches (100). In general inclinations are gelow 6%, though some of 8% occur.

Peculiar constructions were found all over the Empire. Artificial wheelruts (101) were made in certain Alpine passes, the Balkan and the Alpine provinces and in certain parts of Gaul, the gauge being again the same as in early Malta and Greece. Cuttings and embankments were very common. The Via Appia ran through a cutting driven 120′ into Mount S. Angelo near Terracina (102) and near Arricia 43 m retaining walls support the same road. Part of the road through the Medway valley near Rochester was built on a foundation of oak piles (103). In the Kasan pass and the Grében defile on the Danube the road was constructed on a wooden scaffolding let into the rock. Both Tiberius and Trajan made such roads, a picture of which occurs on Trajan’s column. The structure has now disappeared and the road is recognisable only as a ledge in the rocky shore (104). On part of the Via Tiburtina, in order to protect it from the waters of hot sulphur-springs, the road ran in a concrete channel, the outside of which was protected by travertine slabs. The log-roads, first mentioned as “pontibus palude” by Caesar (105) were built on the right bank of the Rhine by Domitius and Caecina (106) after earlier examples built by the prehistoric tribes north of the Rhine (107). These few instances will show the ingenuity of the Roman road-engineer to cope with difficult local conditions.

Control and Financing of Road and Traffic

Many of these roads were built by the army. The excellently organised Roman legions and their army train (impedementa) with large quantities of artillery like ballistae and catapultae needed good roads. Hence in peace-time the army and its engineering corps (the “centuria accessorum velatorum” formed at the end of the Republic) built roads as well as bridges, camps and forts. This was particularly true in Africa and the
Danube and Rhine provinces. During Augustus' reign there were several revolts because of this enforced road-building. Claudius also used gladiators for roadbuilding, slaves and captives were put to this kind of work too.

About 200 B.C. the provincial authorities began to procure additional labour and they gradually took over the greater part of road-building, charging contractors (redemptores) with the actual work and retaining only the supervision. Such contracts were very popular during the Empire but also the source of many frauds. In A.D. 21 "the state of the public roads was made the subject of a debate by the senator Gn. Domitius Corbulo. The highways, he said, were in a bad condition throughout Italy, neglect everywhere and in some places impassible. He attributed the mischief to the fraudulent practices of the contractors and the inattention of the magistrates. He came to superintend the business, but the advantage, whatever it was, that accrued to the public, did not counterbalance the ruin of individuals, who suffered both in reputation and fortune, by the harsh decisions of Corbulo and in the confiscation of their effects." (108) Claudius later punished Corbulo (109). In later centuries the authorities often resorted to forced labour or exactions of money for road building (110).

During early Roman history the task of building roads was entrusted to individual censors, who like Appius Claudius or Flamininus often attached their name to this particular road. Later on emperors, generals or rich private individuals often did the same, prompted by rewards such as special medals, statues, memorial stones or even the right to erect a triumphal arch. Then special aediles called curatores viarum were installed as temporary functionaries, special senators often being entrusted with the supervision of traffic. As legislation on public and private roads became more complicated (111) the emperor Augustus created special permanent boards (22 B.C.) called curationes viarum directly controlled by the emperor for special roads, districts or towns. Nero created the lower rank of subcurator. Many local authorities served on these boards particularly during the later Empire when road-building became less important than repairs and the army left this to the authorities. The provincial roads were administrated by the provincial governor and his nominees, but during the later Empire all these functions were taken by state officers.

Financing these roads was an old problem. The earliest roads were often financed from the booty taken from foreign conquests. An agrarian law of 111 B.C. wanted to make all those living along the road
contribute towards its building and upkeep. In 50 B.C. the senator L. Scribonius Curo failed to push a tax on wheeled vehicles. Usually building and repairs were paid by the treasury from direct taxes. In certain cases emperors or private individuals face the costs. Thus Augustus pays most of the Via Flaminia but leaves part to the triumphant general C. Calvisius Sabinus who then builds his triumphal arch at Rimini. Private individuals or governors have left us word of such acts on milestones (112). Certain towns like Nuceria were granted tolls to raise sufficient funds for road-building (113). The same forms of financing applied to secondary roads (114).

Data on the actual costs of roads are scarce. The curator A. Vibius Temundinus repaired a 20 mile stretch of the V. Caccilia, regravelling part and re-paving the rest of the road in the Apennines at the cost of 150,000 sesterces (£4500) about 80 B.C. (115). The emperor Hadrian repaved part (15 miles, 750 passus) of the Via Appia “paying himself 1,147,000 sesterces, while the owners of the neighbouring lands had collected 569,100 sesterces” which works out to something like £3,000 a mile (116). The same emperor entirely rebuilt this road from Beneventum to Aeclinum (20 miles) at the cost of £18,000 per mile including the price of the land. In view of the size of these “walls” these prices seem comparatively low.

The roads served the army and state officials for whom the state post (cursus publicus) catered. They were also the servants of commerce but one should not exaggerate the volume of Roman trade and commerce in which much of the traffic was carried on only part of the year. Only the navigable rivers and the sea provided cheap avenues to the markets. The Mediterranean was the finest asset in Rome’s imperial economy, even if the Romans always disliked the sea and spoke little of sea-transport (117). The motives of travel in Antiquity differed from ours (118). Apart from the displacements of army troops there was a large amount of official travel and business trips. Sightseeing was not common in the earlier periods. The ancients did not appreciate nature as we do and abhorred the mountains. They went to seaside resorts for their health and later in the Imperial period only tourism to famous towns and monuments became popular, mainly for instruction and education. This is particularly noticeable in Egypt in the second century A.D. However there was a tax on road travel there varying according to the rank of the traveller (119), the tariffs for courtesans were practically prohibitive. This money went into road-building funds.
The provincial governor, in the case of Egypt the prefect (120), had to provide the traveller with a passport. The local authorities surveyed and ran local hostels for officials, but there were many other forms of inns and hostels (121). In the case of important officials travelling abroad special instructions were given and requisitions were ordered (122). Scientists and students travelled to different universities such as that of Alexandria famous for its doctors of medicine (123). Then there were of course pilgrims going to different shrines. Some of these travelers succeeded in getting permission to use the official postal service but most of them had to provide for their own means of transport.

The "cursus publicus", the state postal- and messenger service, was the backbone of this passenger transport. By it the emperors could rule from Rome by letter alone according to classical authors (124). Its origin goes back to the third century B.C. when officials tried to keep in touch with each other and with Rome. Requisitions for travelling facilities were even then possible (125) for senators. Later Caesar gives written permits to travellers and transports. The provincial governors had their messengers (statores) and the taxfarming companies their own couriers (tabellarii) (126). However, we find no definite traces of the postal service said "to have been instituted by Gaius Graechus" (127) though there was some postal service between Rome and Rhegium (128).

The emperor Augustus completely organised and centralised such earlier services (129). The Ptolemaic system seems to have inspired him for he tried to finance it by making the cities and population along the roads pay for it (130). It was first confined to the neighbourhood of Rome but gradually grew to embrace the whole empire under Trajan. Gradually the old system of financing became impossible and Hadrian made it a state-organisation. Private tabellarii were not allowed to use its facilities, which served officials only who had to get an official passport (diploma). However soon private travellers were allowed its facilities as a favour, animals and ships were allotted to private individuals and at the hostels presents lay awaiting them. At regular intervals laws had to be enacted to combat such abuses.

This combined postal-, passenger- and goods-service had strict regulations. Along the main highways there were stops where horses could be changed (mutationes) and larger stations and hostels (mansiones). The mansiones were about one day's journey (37 km) apart. On rivers there were ferries, and the sea routes were covered "dromones" or "cursioriae", fast sailing ships. The diploma rigidly prescribed the
type and amount of transport one was allowed as well as the hospitality in the mansiones. For travel on the secondary roads or branch road one needed a special "evectio".

The heavy clabulariae (angariae) drawn by oxen carried a maximum of 1500 Roman pounds each (492 kgr) of army goods, parchment and papyri, products from the imperial estates, etc. The number of oxen or horses for this slow cursus clabularius was 8 in summer and 10 in winter, lower officials were allowed only this form of transport, also soldiers if travelling far and all sick people. Express goods and precious metals were transported by the cursus velox which used several types of carriages: 1) the rheda (vehiculum, carpentum), a four-wheeled cart with mules (8 in summer, 10 in winter) and a maximum load of 1000 lbs (330 kgr); 2) the carrus, a four-wheeled cart carrying 600 lbs (198 kgr) max.; 3) the verreda, originally used by women only, which was drawn by 4 mules and could transport 2—3 persons and max. 300 lbs (99 kgr.); and finally 4) the two-wheeled birota with 3 mules carrying 200 lbs (66 kgr) and 1—2 passengers. The cursus velox also had riding horses (veredi) and pack-horses (parhippi) which carried a maximum of 100 lbs (33 kgr). The animals served only between certain mansiones and had to be exchanged at certain determined spots. Their hay was to be exacted from the local population. The mansiones also served as central offices for all taxes paid "in natura".

The cursus velox could only be used by high officials, their families and the imperial messengers (tabellarii) (131). Originally this service was controlled by the praefectus praetoriae but later a special official vir illustre magister officiorum was appointed. The maximum loads of the different types of vehicles was carefully prescribed to avoid excessive wear of the roads (132). The average speed of the imperial post was some fifty Roman miles a day (5 miles per hour) (75 km). Special despatch bearers did sometimes attain double that amount, but 240 km a day allowing for halts is the maximum ever reported (133). It was certainly already better than the 24 miles which Cicero could do in 51 B.C. as a provincial governor (134). The regularity, certainty and speed of travel of the cursus publicus were not surpassed until the days of Napoleon. The ox-drawn carts travelled some 10—15 km a day.

The Romans tried to reduce the time of land transport and to increase its capacity in order to overcome the difficulty of feeding the great cities. The solution adopted was a control of most of the land and sea transport by liturgical (compulsory) services. Stables were built by forced labour, one quarter of the horses needed for the mansiones were
requisitioned yearly from the population living nearby. The excellent effort broke down even when economy dominated road building during the later Empire. Transport costs, which doubled the price of grain for every 100 miles of transport, were so high as to make the carriage of wares, whose value was small in relation to bulk or weight, over any appreciable distance out of the question. Corn, ores or metals went straight to the nearest harbour and then by water. Thus local traffic may have been dense but long-distance transport was negligible. The development of roads helped only in a few cases, e.g. it brought down the price of vegetables in Rome.

The great and apparently beneficial road-system broke down through official abuse and the fundamental mistake in providing for its maintenance by compulsory exactions. There was an increasing and often fraudulent demand for free transportation of military and state officials. The municipal authorities already loaded with work could not exercise a proper control. Drastic reforms by Julian, Valentinian I and Theodosius helped only temporarily. The imperial fiscal administration had by the time of Constantine already destroyed one by one all the chief sources of revenue and traffic by land and sea gradually dwindled to a fraction of its former volume as private enterprise was completely absorbed by the state.

Having already mentioned milestones and direction posts as aids to travellers we should now devote a few words to maps and travelling handbooks. The Babylonians and their ancestors had had their maps (135) and the Greeks had greatly improved this art (136). Cartography was a well-known art at the beginning of our era. Maps of all types were available (137). During the consulate of Caesar and Mark Antony a survey of the empire was started by Zenodoxus, Theodotus and Polycritis and finished in 25 years. Augustus’ friend M. Vipsanius Agrippa ordered a new survey of Spain, Gaul (including the Low Countries) and the Danube provinces. The results were embodied in a sculptured marble map hung near the Pantheon at Rome. A 40’ × 60’ marble map of the 14 quarters of Rome was ordered by Vespasian, parts of this “Forma Urbis” have survived.

There were also maps for the general staff which accurately depicted the roads, the mansiones and their distances (138). A fragmentary copy of such a map on the leather shield of a soldier of Dura Europos gave the route and mansiones on the Black Sea highway from the mouths of the Danube to Artaxata in Armenia (139). It is the prototype of later “itineraria” like that of Ravenna (VIIth century A.D.) and the Peutinger
map made by Castorius, of which we possess a copy of the XIIth century. This latter map is mathematically deformed to suit the pocket in the form of a roll, but all the distances are marked correctly (140).

Part of the troubles of ancient land transport sprang from the inefficient use of draught-animals (141). This was first of all due to the ancient form of harness, which was not a shoulder-collar with breast-strap, but which throttled a horse or mule that pulled too hard. Each animal could pull a maximum of 62 kgr, only a quarter of the modern figure. Also the only way of yoking more than one animal to a cart consisted in augmenting the amount of yokes. The Romans did not know how to arrange them in line tandem and thus not only complicated their manipulation (by multiplying the number of reins) but also reduced the total energy-output considerably.

Again horses were not shoed in Antiquity (142). Though the problem is still far from settled it seems that the ancients knew metal, leather or straw soleae, hypodemata or hipposandales attached to the legs of horses, mules or camels if the ground was hard or slippery. Real iron horseshoes, attached permanently with nails, seem to have been adopted from the nomads by German, Aleman, Helvetian & Sueban tribes of prehistoric Europe about the second century B.C. In the northern Roman provinces a few horseshoes were found before they become common about the eighth century A.D. Then a type of horsehoe with a better grip on the hoof were generally used from which type the different local European types began to evolve in the ninth century, when the emperor Leo mentions them in his Tactics, together with the rein and the stirrup both unknown to the Romans (143), which made riding a horse more difficult and which hindered the evolution of cavalry as a heavy arm.

Stirrups and horseshoes contributed to the rise of cavalry as an important “shock-tactic” element in warfare and they formed one of the cornerstones of the rise of chivalry, the mounted gentleman and his retainers who rode the highways in Chaucer’s days along with the travelling clergy and merchants.