Sustainable Transportation Systems
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Lecture - 01
Introduction to Transportation Systems - I

Hello friends, welcome to this NPTEL course on Sustainable Transportation Systems. Today is the first lecture I welcome all of you who have registered for this course, and I hope that you will enjoy this course from the beginning of the introductory lecture to the last final lecture on related to policy aspects or various concluding remarks related to the integration of the transportation system.

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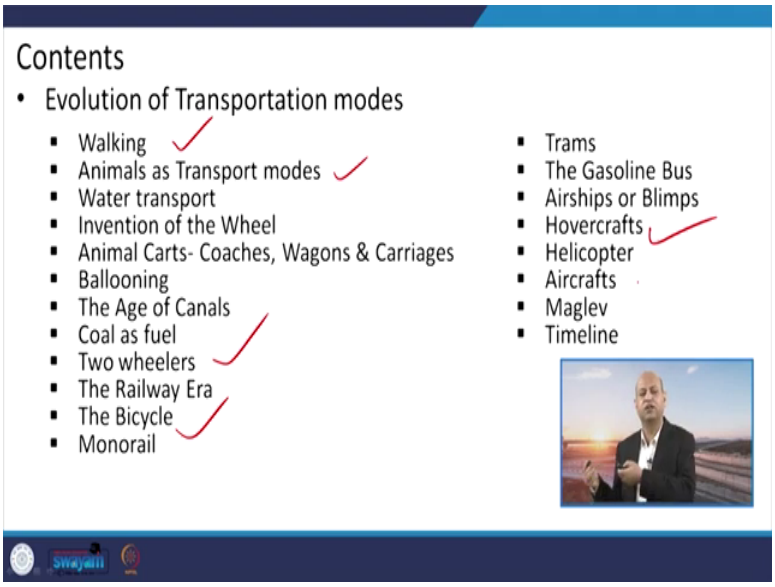

So, today, we will give you an introduction or an overview of the evolution of transportation modes like what was the initial way of transporting from one place to another and what is today's transportation mode. So, in primitive ages, you know, there was nothing when civilization started to build, there was nothing kind of transportation system except that we were walking.

So, mobility is there in nature you can see everything is moving from one stage to another. So, even animals are walking or moving, then birds are flying. So, there is you know transportation from one place to another. Similarly, human being also walked from one place to another place.

So, from working to then using the animals for transportation modes or water transport like canals, rivers, and then invention of wheel which really revolutionized all transportation modes, and then also like dreaming to fly like birds. So, invention of aircrafts or ballooning and then reusing fossil fuels and that also was a big revolution in transporting from one place to another through fossil fuelled vehicles.

And then two wheelers or and then railway era came when steam was used and coal was used for producing the steam. And then bicycle or monorail, trams, gasoline bus or hovercrafts, helicopters, aircrafts, now, even spaceships are also there. So, there are so many kind of transportation modes available today, but how these kinds of transportation modes were evolved. So, that is interesting journey, we will go through in today's lecture.

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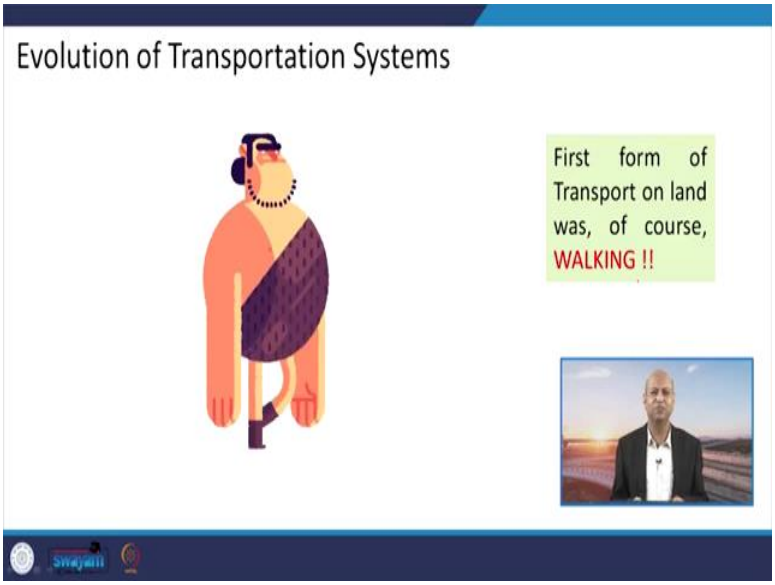

Well, so, this is one very fascinating animation, very simple, amusing animation, which shows that the first form of transport on the land was of course, walking, just using our own legs.

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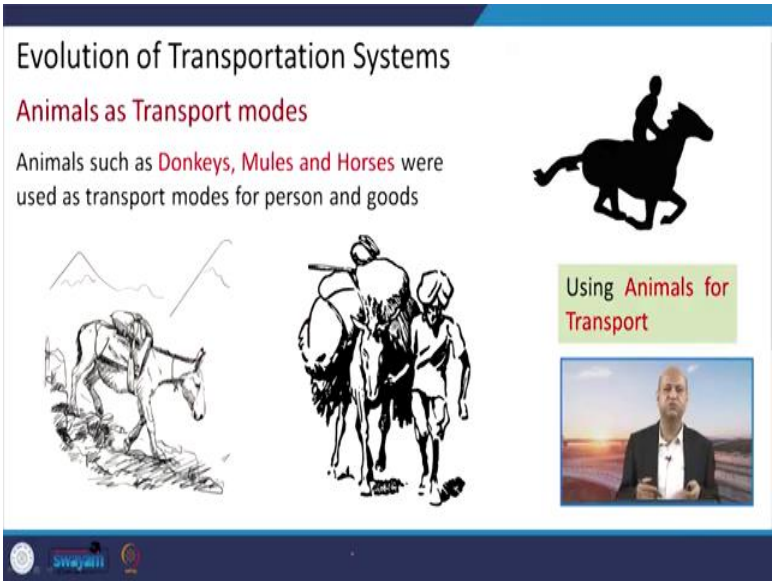

After that when animals were started to get tamed, and we started to use them for domestic services, so, horses and donkeys, all those kinds of animals were used for transporting goods as well as transporting oneself.

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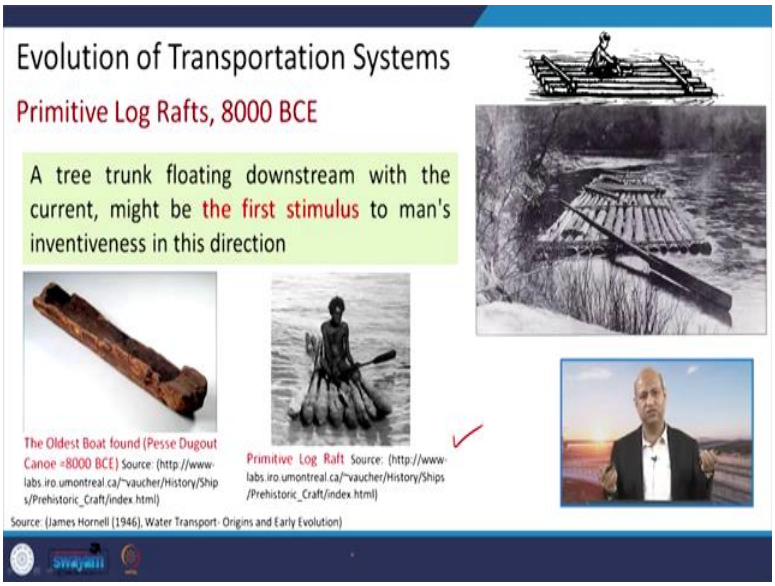

Then someday you can assume that human being got perplexed or got surprised that how this log of the would is floating on the water and moving from one place to another. So, that might have given this aha feeling, okay, I can put together different log, these logs and maybe this kind of system was invented for transporting through rivers or through lakes, etc.

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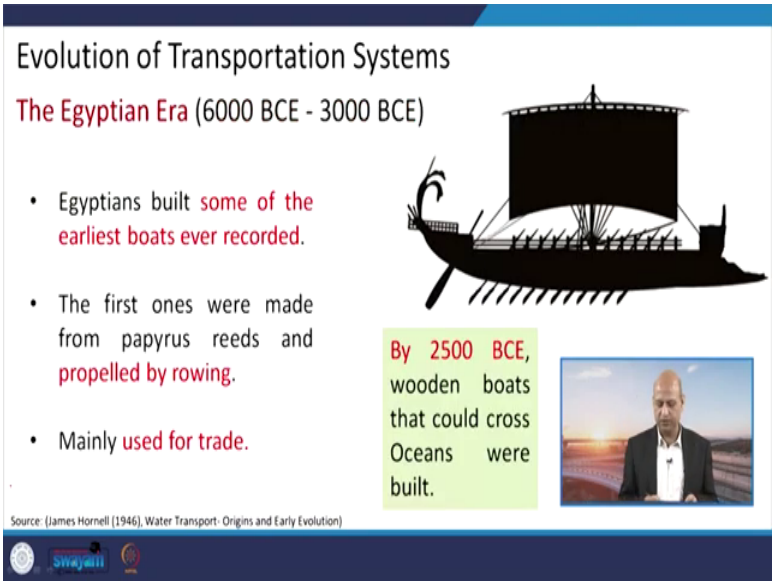

After that, in 2500 BCE, this wooden boats of very good form were developed. So, this Egyptian era from 6000 BCE to 3000 BCE, there were evolution in the boats, and they were used for trades also, not only persons traveling from one place to another, but for trading purpose also.

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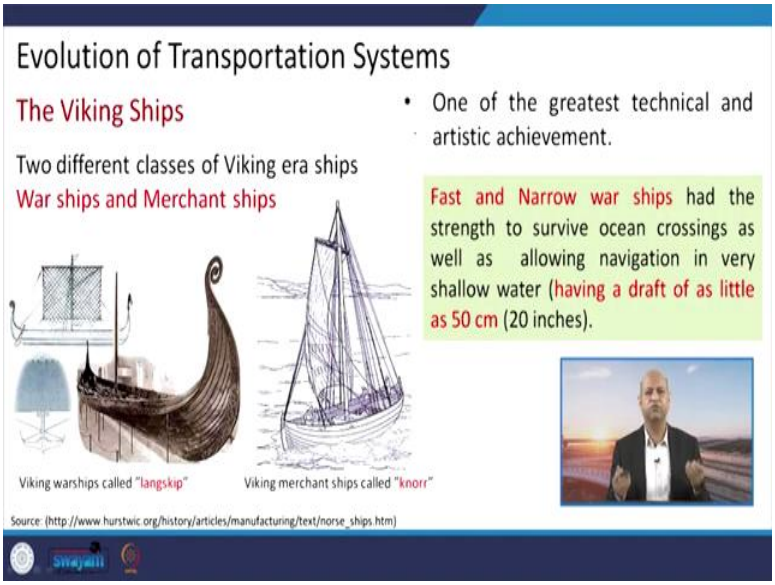

Later on further refinement happened and warships were also built. So, warships had their own requirement like they had to be navigating in very shallow waters also. So, those were designed in that form and these ships which were used for passengers or transporting goods, they have to be deep and so accordingly those designs were developed.

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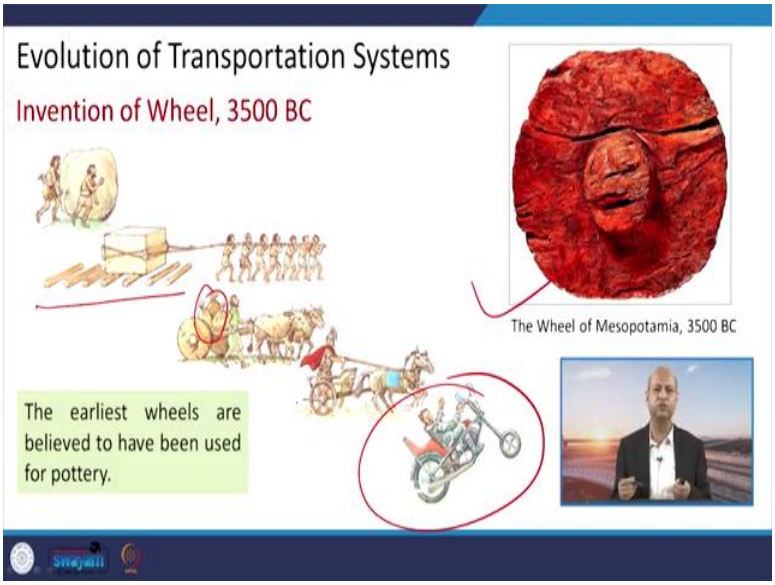

Then this invention of wheel came and after that complete scenario got changed because after that bullock carts or horse carts, many things came into existence even all these transportation system based on vehicles or automobiles, they were also invented later on. So, wheel was the great revolutionary part of our journey towards the transportation system.

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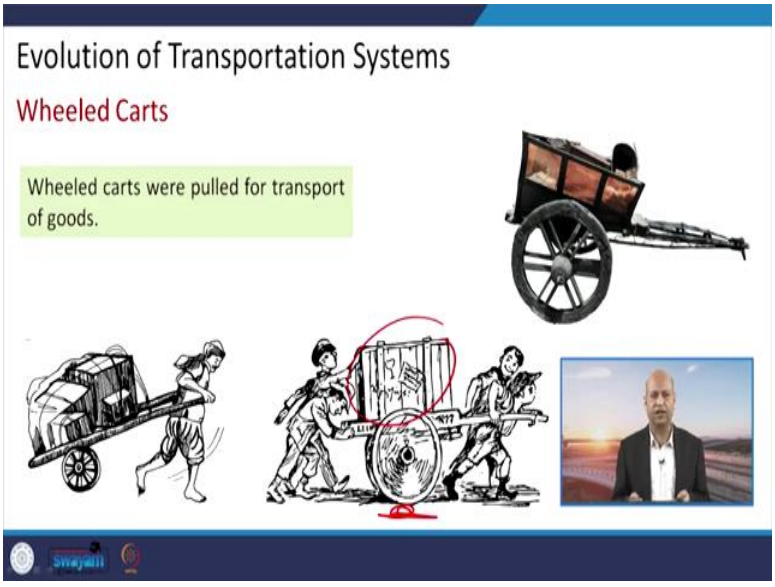

Well, so initially when these wheels were invented, as you can see this physical phenomena that very less friction is there, because this area which touches the ground is very less. So, it is very easy to move even heavy things with the help of the wheel. But initially, only human beings used these carts to move goods from one place to another.

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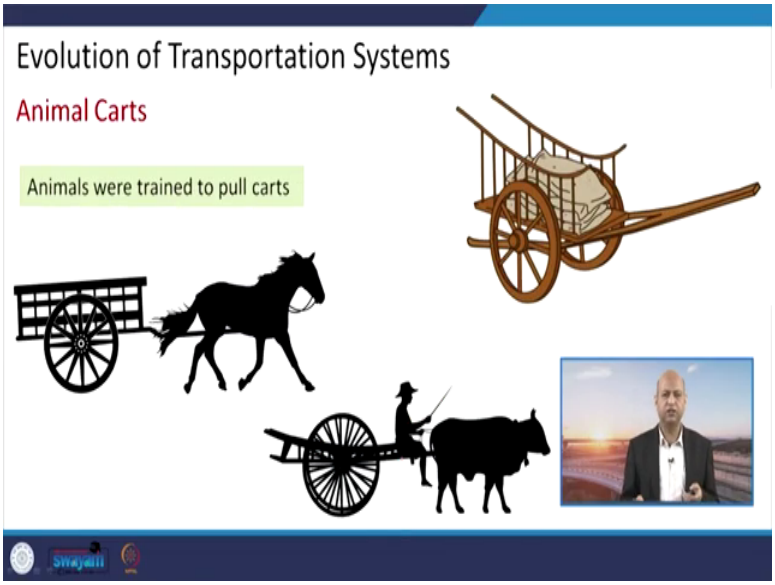

And later on, when animals were tamed properly, then bullock carts or horse carts were used.

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And even in these carts, again, refinement happened and to carry more people like these kind of carriages were developed.

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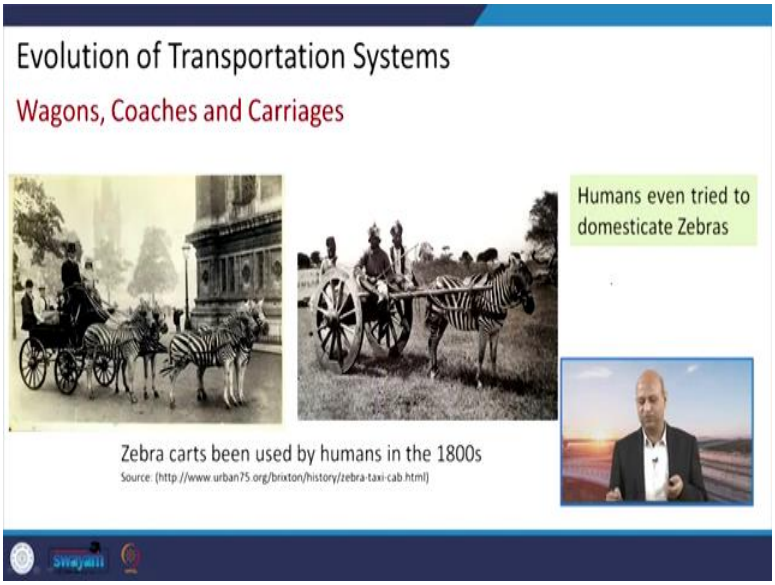

Later on, this is one amusing kind of thing that zebras were also tried to tame and they were used for zebra carts, but perhaps they were not very effective or efficient, like horse carts. So, later on, only horse carts were used.

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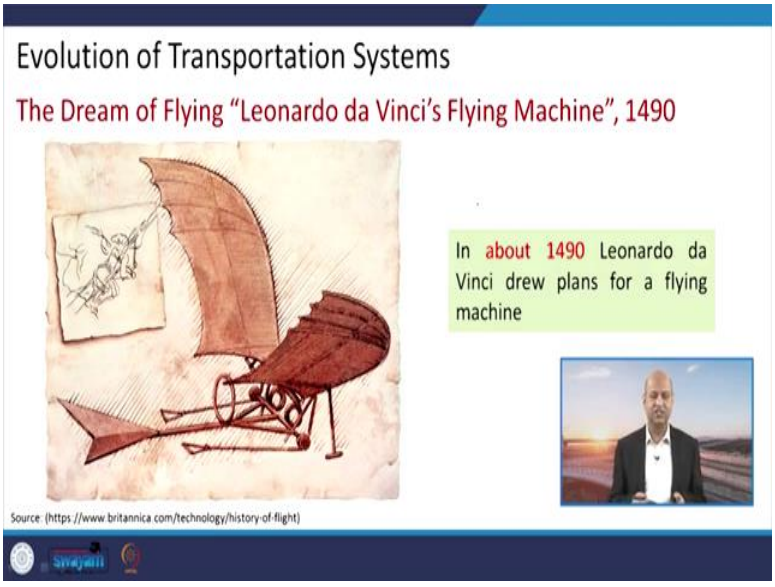

But then, our imagination, our creativity, so when human beings saw birds flying from here to there, they thought why cannot we fly and in 15th century, like around 1490, this great inventor and scientist and he was multi-talented person, Leonardo da Vinci, he dreamt for this flying machine and he designed you can see, like these kind of wings are also there. So, that kind of design exists in his literature.

But, sometimes concepts come but then it is put in backburner, and people do not work on that. And later on, somebody picks it up and follows, and then something brings out of this.

So, later on we will see that how these airships were built, but after Leonardo da Vinci that there was not much progress.

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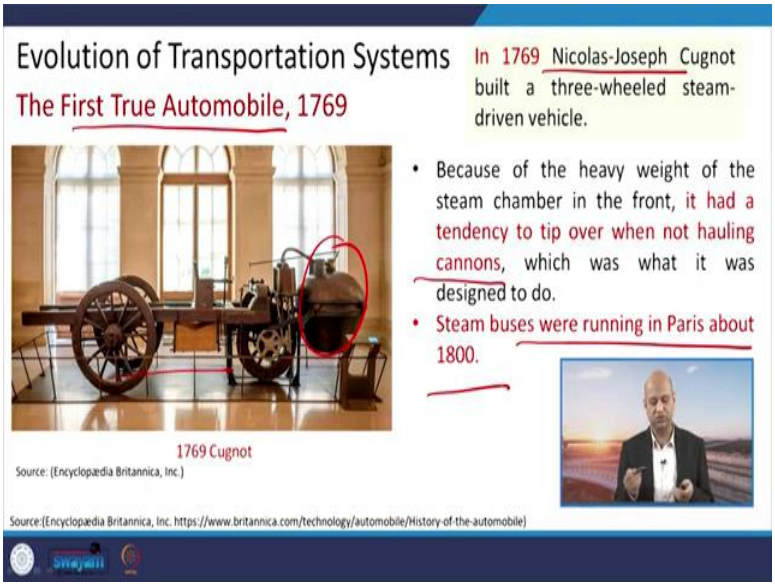

So this evolution took place and the first automobile based on the steam was this three wheeled structure. So, this was the biggest structure for steam generation and uses. And this was used for basically transporting cannons. And this could you not tip over if there was no cannon, so design was not very comfortable. Well, the steam buses were running in Paris in 1800. So, those kind of developments were happening in Europe.

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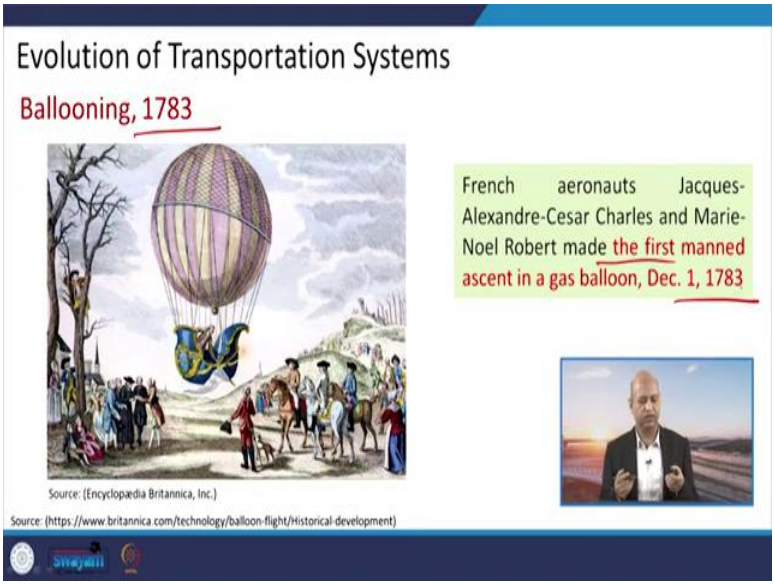

In 1783, these balloons were again, means balloons were invented and for taking people from one place to another, but these were not very popular. Even today, balloons are used for metrological observations, etc. But this was a big invention at that time. 1783 this was the first experiment that balloon was used for flying from one place to another.

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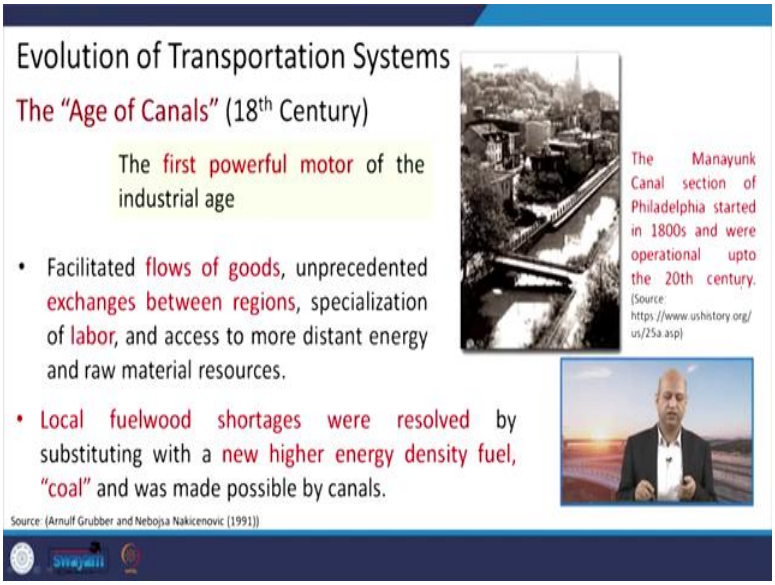

Well, then in 18th century, the canals were used or this was the era of canals you can say, so that means for transporting goods or transporting people through boats, through small ships, and the canals were built everywhere. And the place where I am standing, IIT Roorkee, the journey of this institute also started because of Ganga canal, when engineers were needed for building canals, for surveying, for several designs, and construction of the canal.

So, engineers are needed and the first engineering college for Civil Engineers was established in Roorkee. So, that was the era of canal and everywhere these were built for several purposes, including drinking water, water for irrigation, and for also transporting goods.

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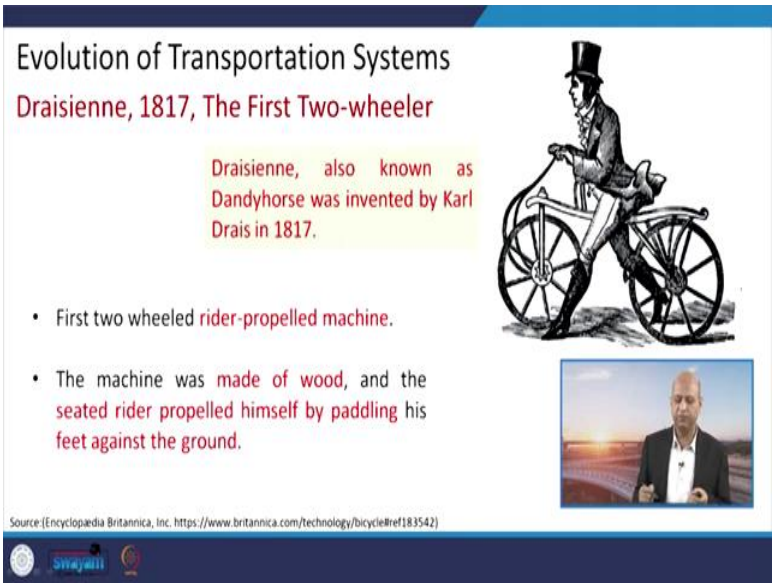

Well, at the same time these two wheelers also were invented. So, this was the initial design of the cycle, there was no chain. So, by muscle power only people used to just drag it you can say and they could push and then they can sit on the seat and then like these children use the scooter like pushing and then using it.

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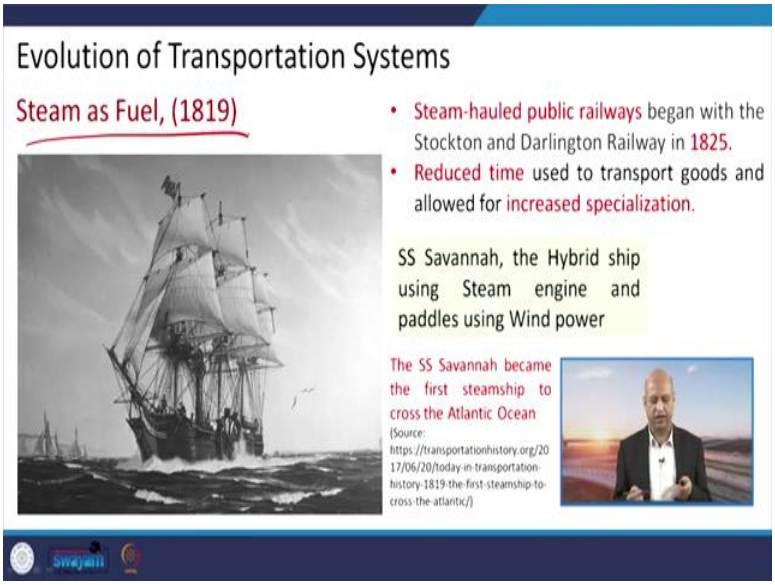

And in between these steam as a fuel was used for powering these ships also, and steam hold public railways were also there. But ships were also there, so means land transportation, as well as you can say waterways transportation or transportation through ships and rivers. All those were there in parallel. Yeah, wind powers were there but those were used for different purposes. So, this was the time in 1819 that the steam was used for driving force of the ships.

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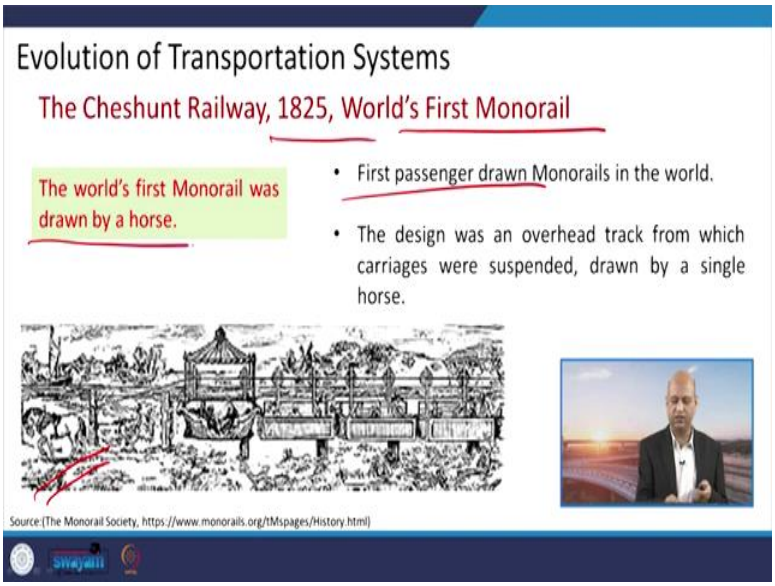

And then you can see in 1825 this world's first monorail was invented and this was drawn like a first passenger monorail, but it was pulled by horses. So, it was not today's monorail, but again the animal's power was used and this was drawn by the horse.

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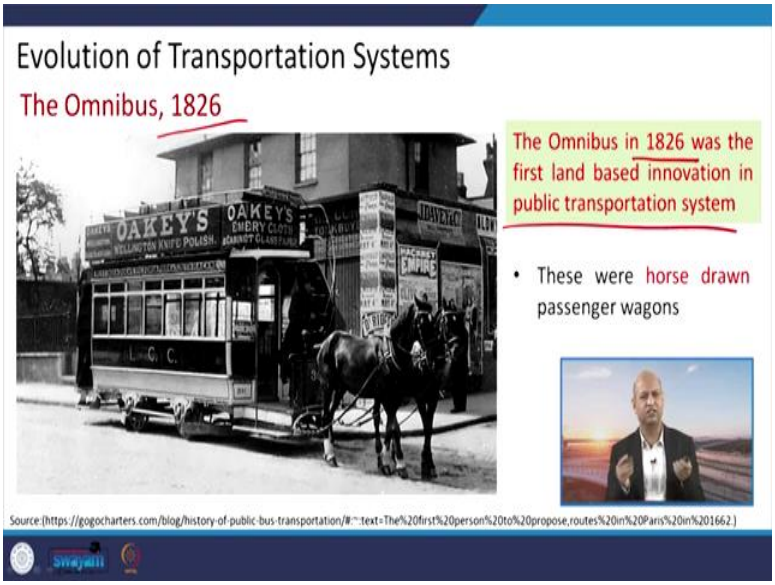

Ok, then this was the time like 1826 when Omni bus as a public transportation system, so it was also horse driven, and but many people could ride on this particular bus. So, this was the initial design of the bus driven by the horses.

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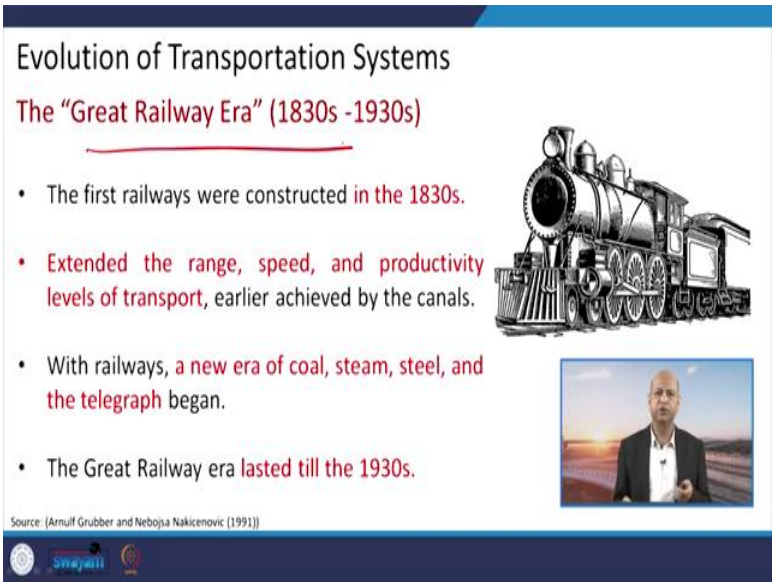

Well, then railway era came into existence from 1830s to 1930s. And this was the age when a lot of tracks were laid down and this was the power of the steam. So, several fold kind of power increased, because this technology of steam engine was used in a big way.

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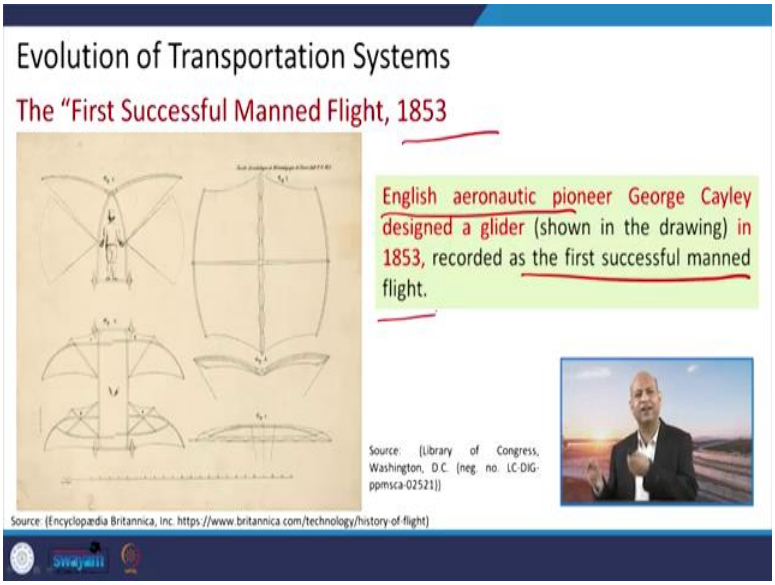

But this the dream of flying was continuing in the mind of the human being. And in 1853 this English aeronautic pioneer George Cayley, he designed one glider, this kind of design he produced and this was the first successful manned flight. But it still it was not getting into that kind of evolution, which we see today of the air journey, it took several more years, when aircrafts were properly developed.

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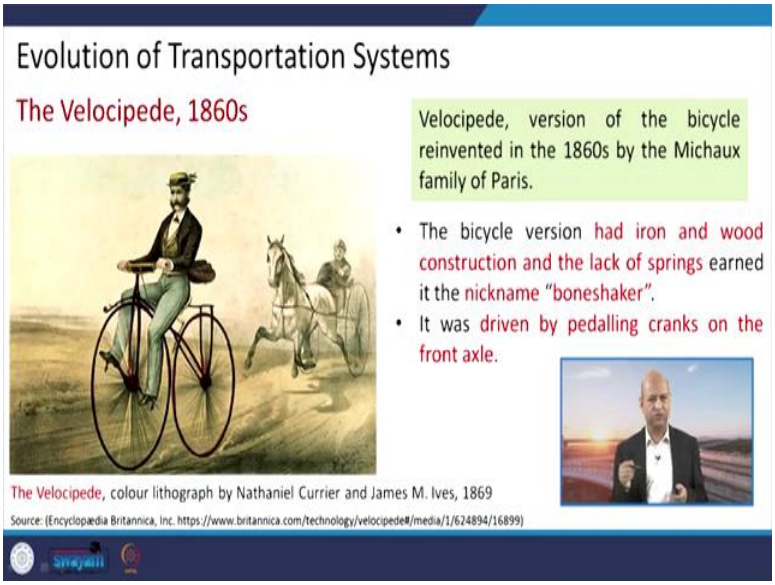

Then in 1860s or 19th century you can see these bicycles and because of this wheel and several forms of transportation modes were invented. So, this kind of bicycle came into existence, larger wheels and from the front wheel he is trying to pulling it, but later on the rear wheel was used for pushing through the chain you can say.

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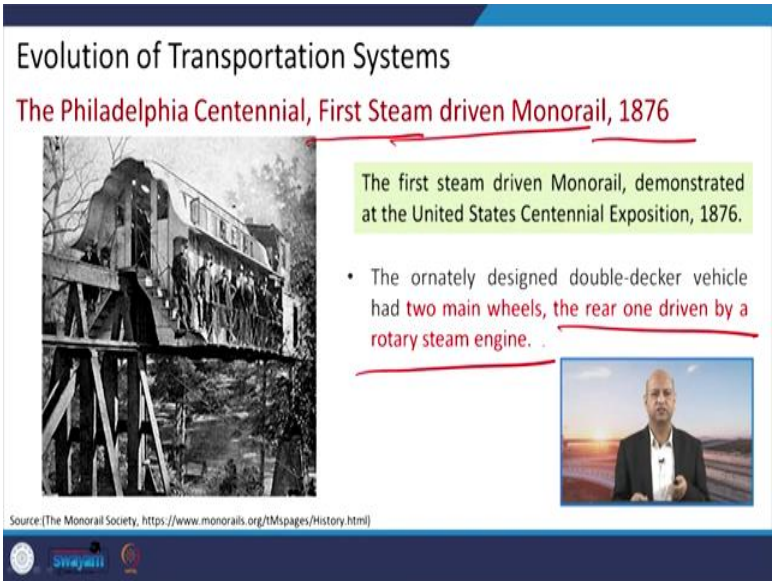

At the same time, you could see in 1876, this monorail by steam engine. So, this was the monorail by steam engine, earlier it was by the horse. So, these kind of new inventions were there and it was kind of rear one driven by a rotary steam engine. So, these kinds of technologies were into place.

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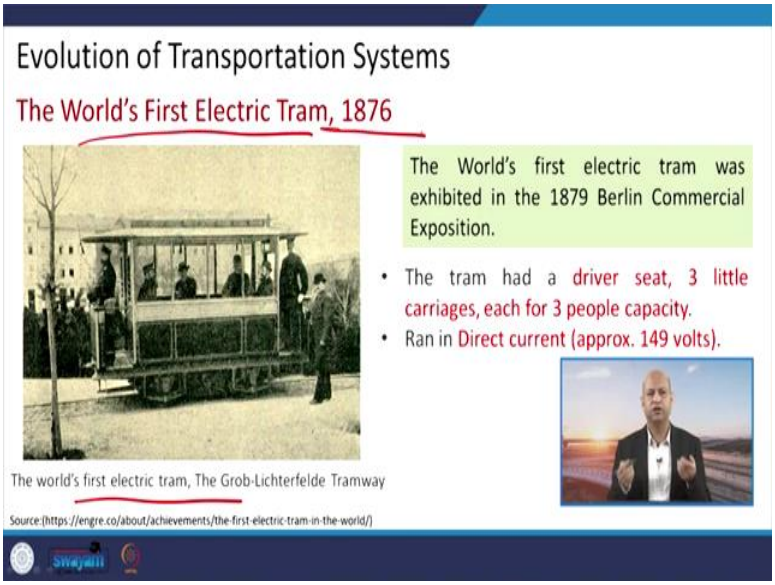

So, in 1876 this world's first electric tram was invented, but as I said that many kind of inventions took place in parallel. And it took time when one invention grew up to that scale, where it became kind of mass popularity or those kinds of things.

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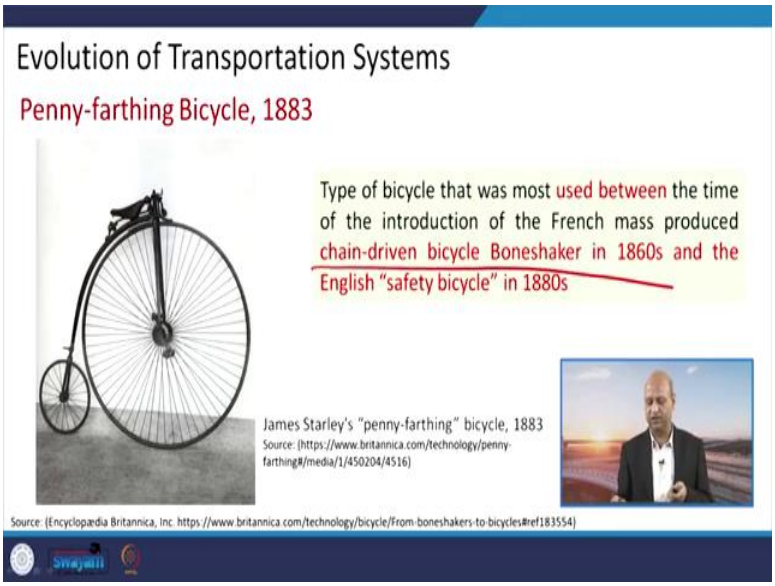

Well, this is again a new kind of bicycle that was the evolution this was the chain driven bicycle. So, that was one more addition to the bicycle.

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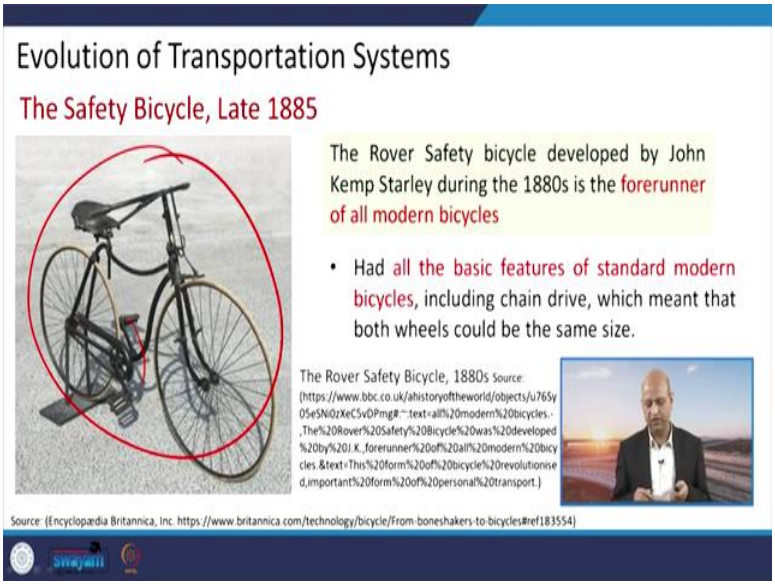

And this is the real model which basically we today look at by chain and this pedal. So, this is the pushing kind of mechanism which became later on very popular and still all those bicycles which we are using today is the refinement of this particular design.

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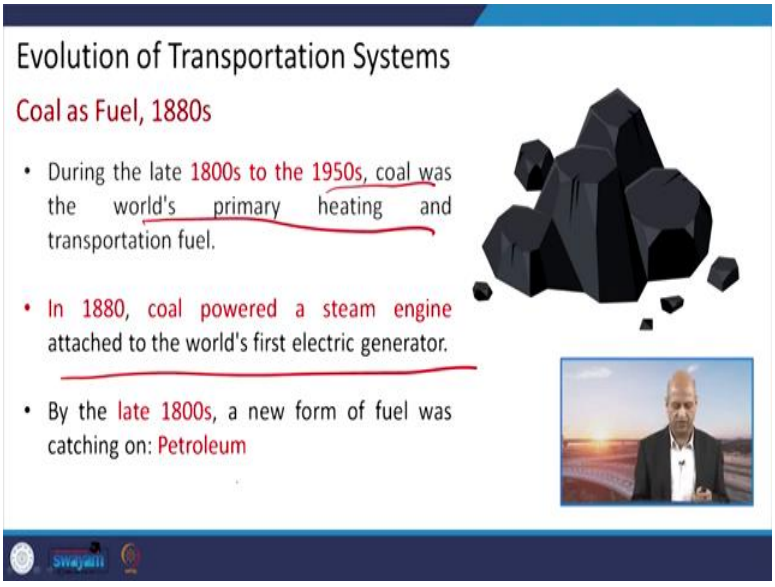

But later on again, it became part of steam generation means direct fuel, and then indirect fuel, means producing steam and then using the steam as the fuel for driving the train or driving some particular engines. And later on this petroleum was discovered and the gasoline, diesel, those kinds of fuels came into existence.

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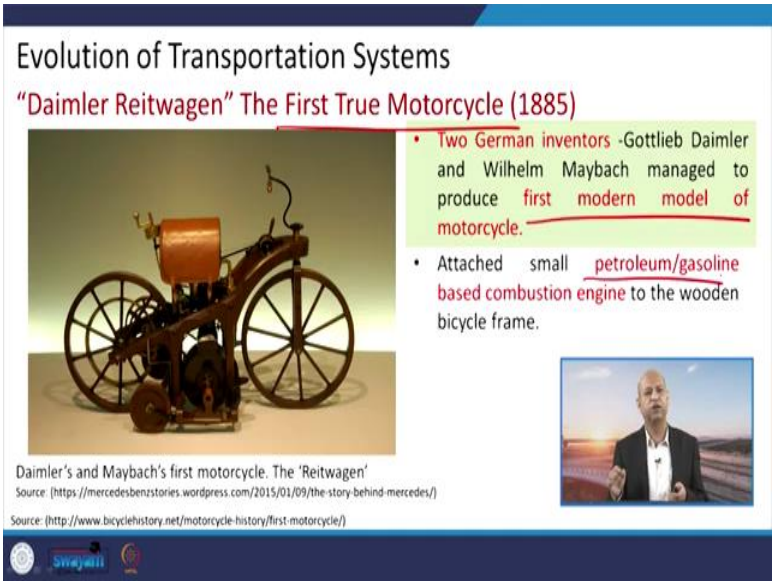

So, this is the first true motorcycle you can see, two German inventors, they invented it. And this is the first model of the motorcycle, which was driven by petroleum or gasoline. This is very rough design of that time 1885.

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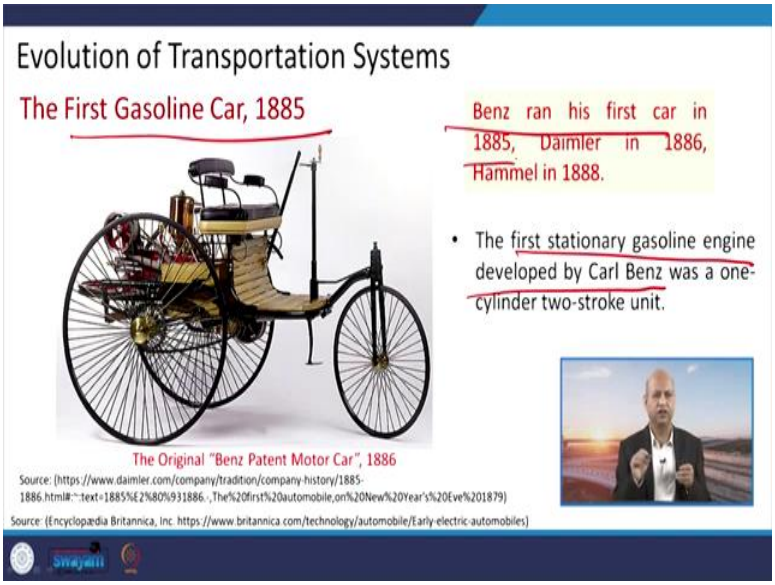

So, when gasoline was discovered and this was the more clean fuel in comparison to the coal and more efficient also, more effective, more powerful. So, this gasoline car was invented in 1885. And later on various models came up to this like today we have very fancy cars also. But this was the first stationary gasoline engine developed by Carl Benz, so this Benz ran his first car in 1885. This is the record of that particular car.

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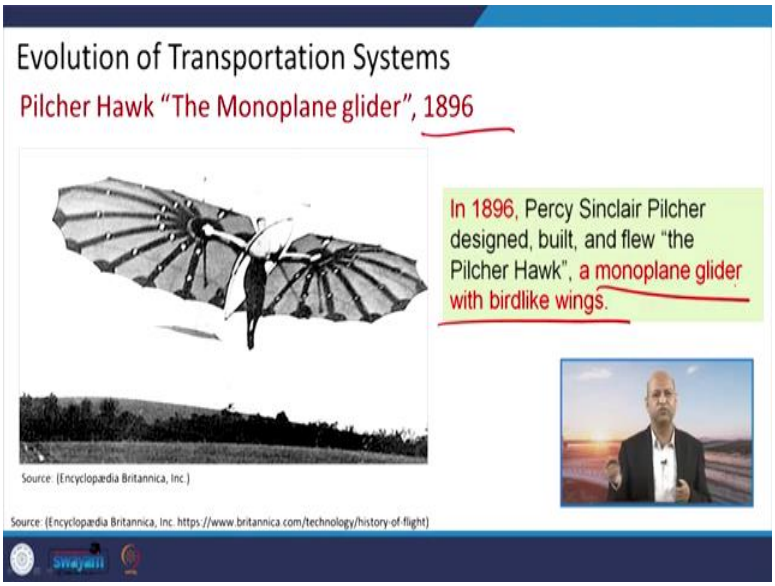

So, in 1896 again, someone tried to like fly like the birds, but this was the monoplane glider and it was used in 1896. But still it was far away from the modern aircrafts.

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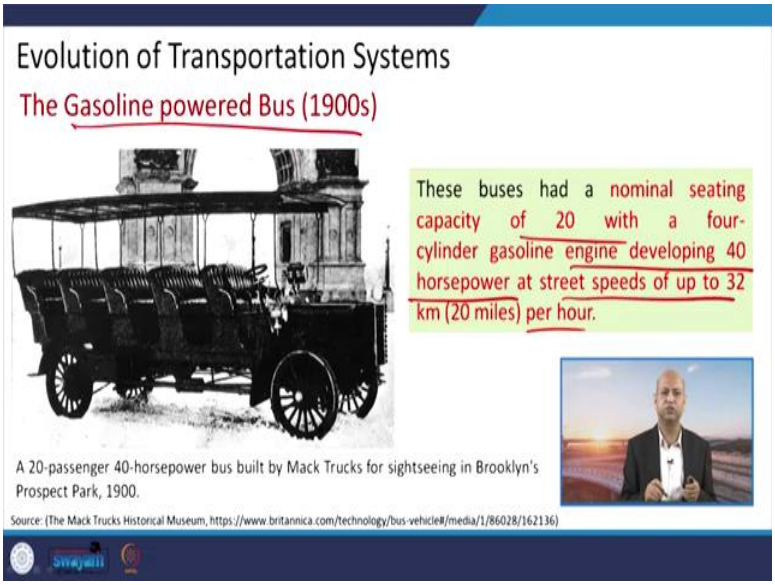

Well, gasoline powered bus in 1900s. So, this was the public transport kind of system. So, this could carry 20 people and like engine developing 40 horsepower at street speeds up 32 kilometre per hour that kind of speed was achieved by this, this was big revolution at that time you could imagine.

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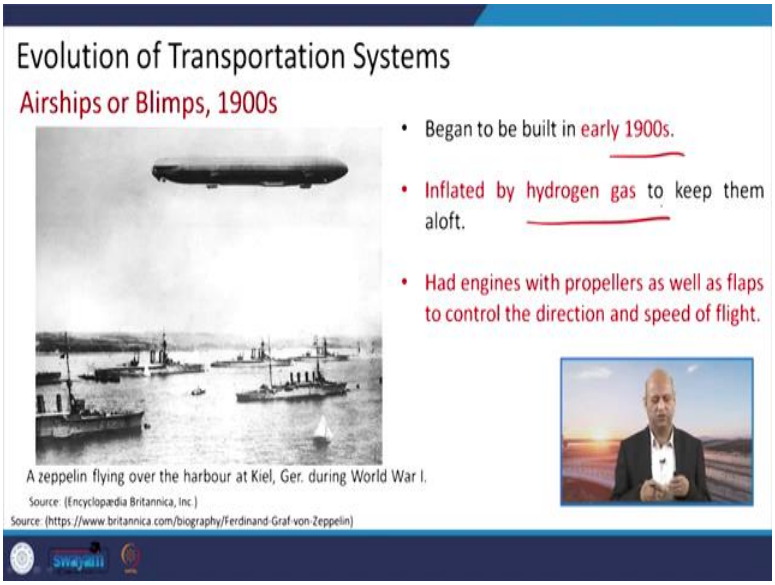

During that these airships or blimps were also invented before these aircrafts. So, they became little bit popular in 1900s, inflated hydrogen gas was used, but it was not used for longer because of certain shortcomings, including like fire hazards, etc.

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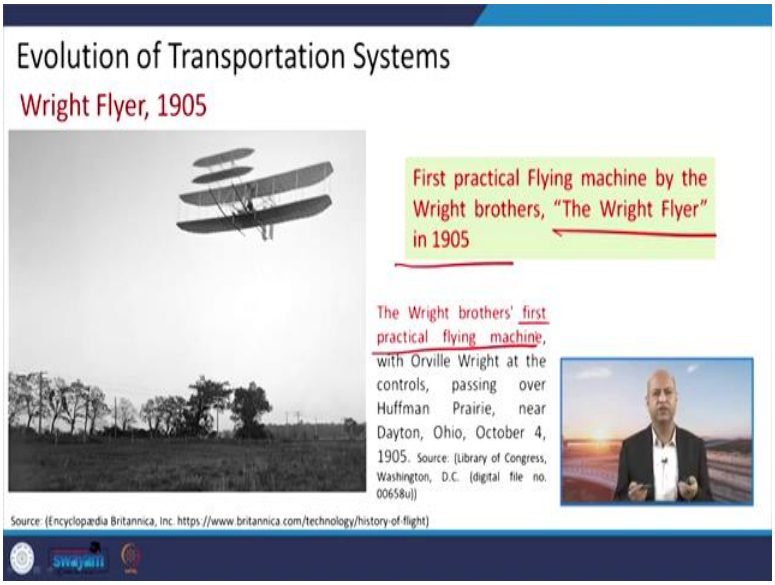

This was the revolution in case of aircrafts in 1902. Wright Brothers, Wright Glider, this was invented and later on, the proper flight was in 1905. This Wright Flyer is known as, this was the time when Wright brothers first practical flying machine was used for the flying, this was the demonstrated and this is the era when aircrafts, and this air journey started you can say, this was the basic starting point in real sense, otherwise, imagination drawing design were earlier.

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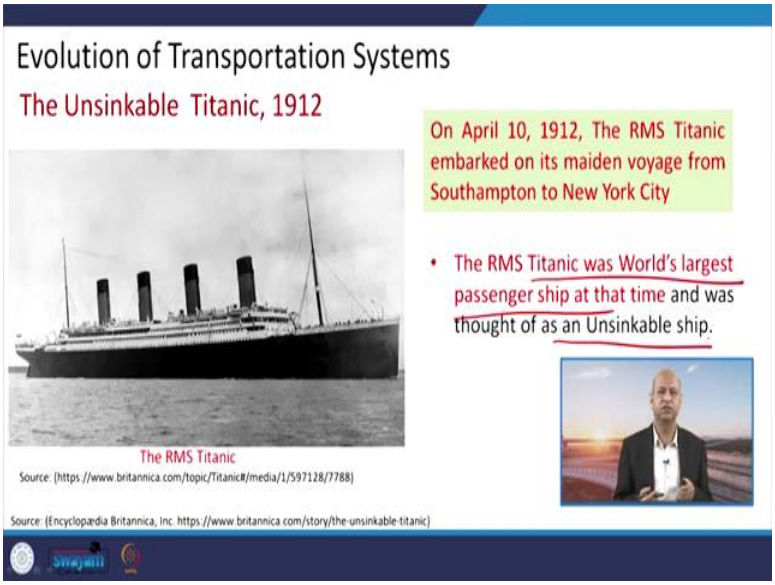

In parallel in ships also, there were lot of technological interventions. And you could see this Titanic was the world's largest passenger ship that was designed at the time and it was thought to be unsinkable, but you might have seen in the Titanic movie that how this unfortunate incident occurred and because of accident with the iceberg, it sank and these

kinds of rare incidents also happen when we do not expect but it sometimes happen. But that was the technological masterpiece in that era.

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Well, automobiles, luxury automobiles, those kinds of things, then improvement occurred and better cars were placed on the roads. So, Henry Ford, he gave the world in 1908 this first mass production of vehicles kind of factory, mass production, he started to produce cars, and that we like earlier only few people used to have these kind of artifacts, but later on, because mass production, they became cheap and common people could also buy.

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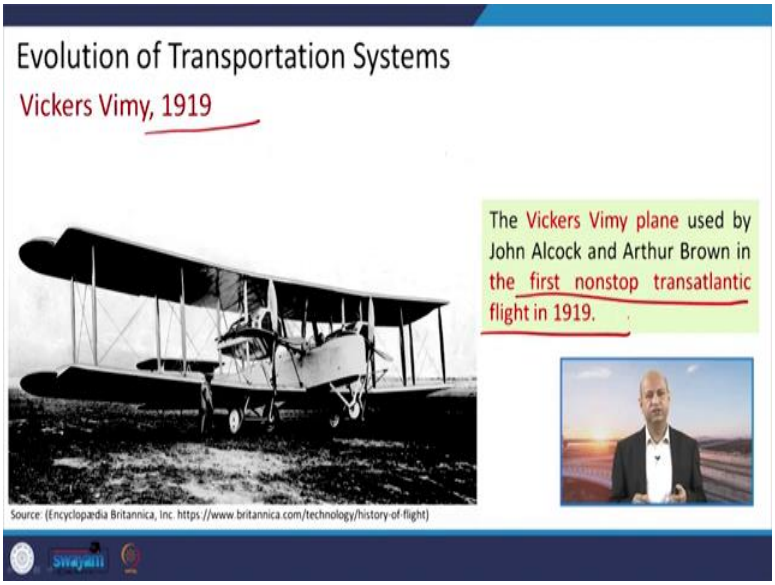

Well, in 1919 then evolution occurred in this plane, and this was the first nonstop transatlantic flight that took in 1919. So, this was a big, big news at that time that these airships can be used for intercontinental journeys. Means this is the time when it started that maybe aircrafts could be a new way of transportation from one country to another in addition to the ships otherwise only ships were there for going from one place to another.

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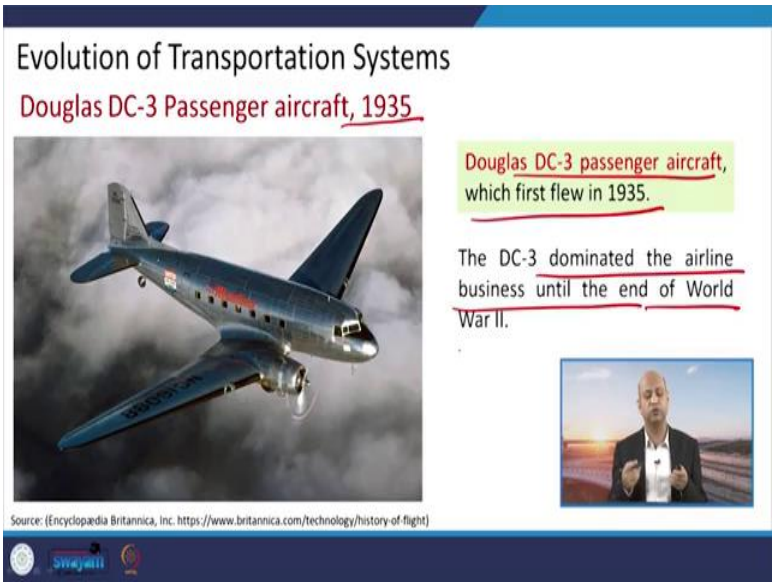

Well, then in 1935, this was Douglas DC-3 passenger aircraft which first flew in 1935, and that way, this airline business was dominated by this particular aircraft up to the end of the world war second. And in World War second, these airplanes played very important or critical role.

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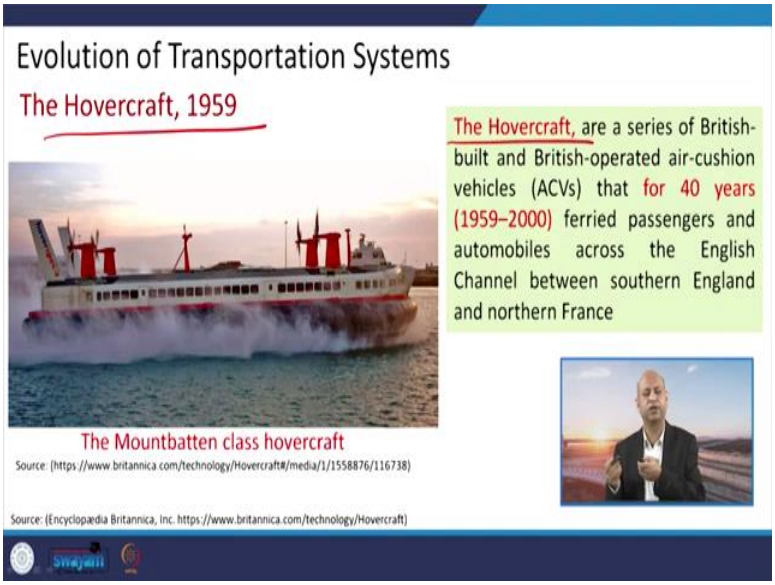

Then hovercrafts in 1959 which could be used on the sea as well as on the land. So, those were the inventions of hovercrafts, but they could not be picked up by like other means of transport like ships or aircrafts, etc.

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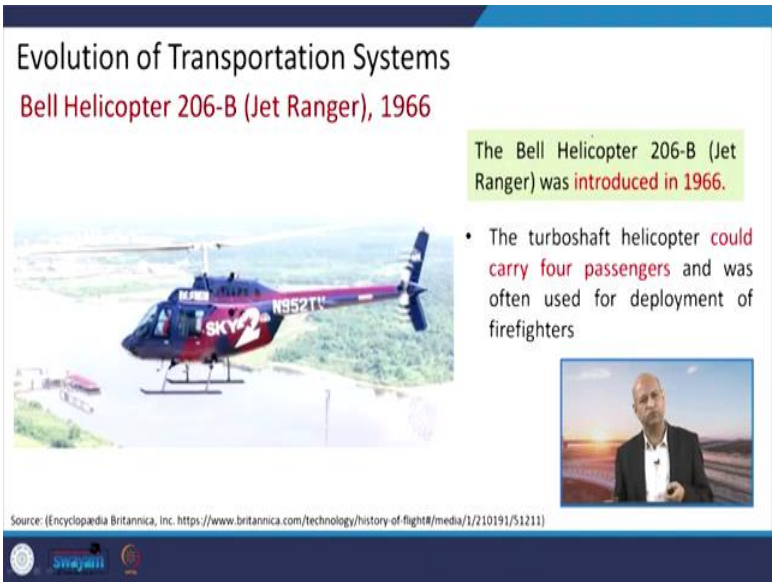

Helicopters were also invented, but again, those were not for mass transportation, etc., they were more for like defence or for carrying some patients from one place to another in a hurry or those kinds of things helicopters were used.

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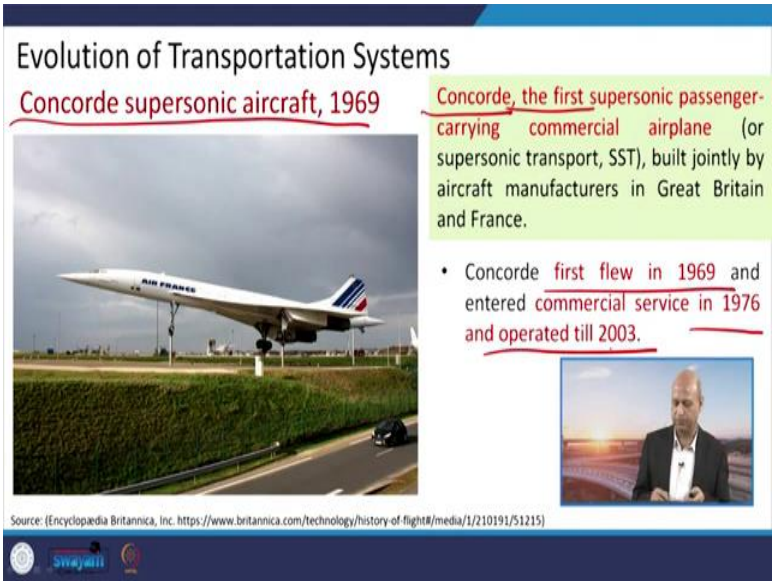

Now, this was the big invention in air journey, this supersonic aircraft in 1969. It was invented this Concorde and from 1976 to 2003, this operated as commercial flights, but these were very expensive, and there were some issues related to safety also. So, after 2003 it was taken out of the market.

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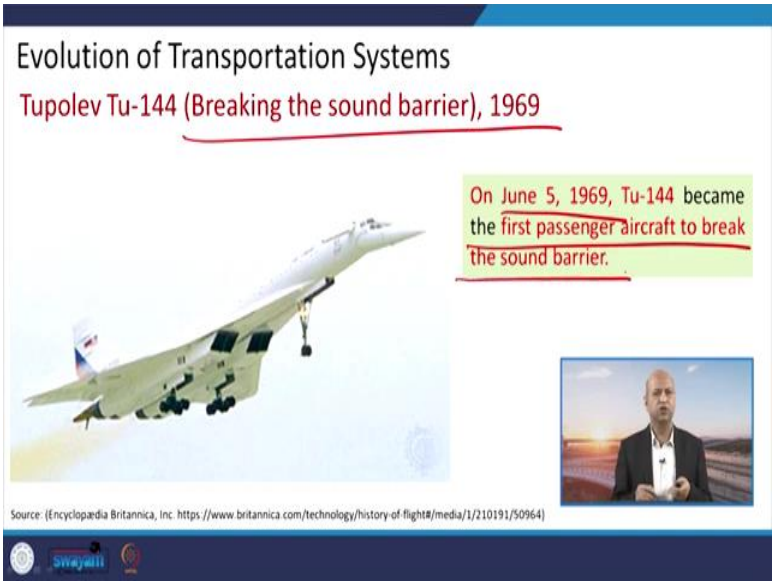

This is another, Tu-144 breaking the sound barrier in 1969, on June 5, 1969. So, in parallel to that Concorde, this was another supersonic kind of aircraft, which was first passenger aircraft to break the sound barrier. So, I mean to say new inventions were going on in a big way, technological inventions in air journey.

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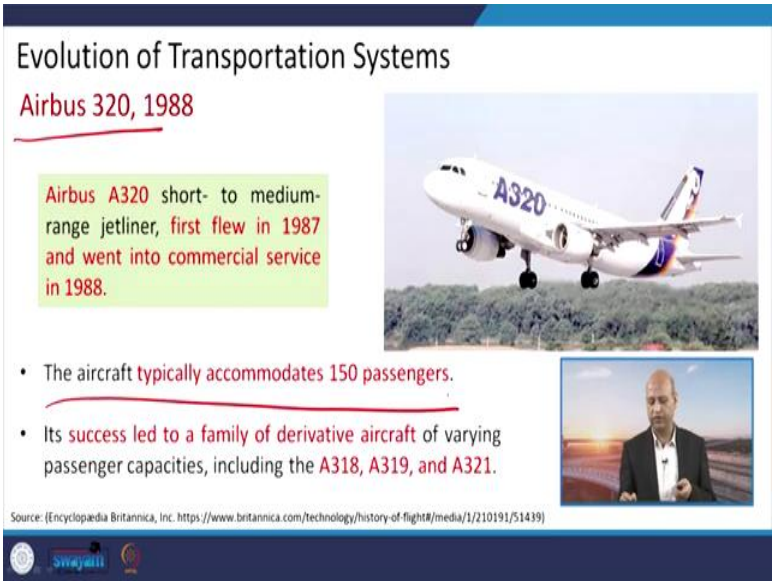

And then this Airbus 320 in 1988, so, Airbus and then Boeing, all these companies produced lot of good aircrafts and they became commercially viable. So, around 150 passengers could be taken in this particular aircraft.

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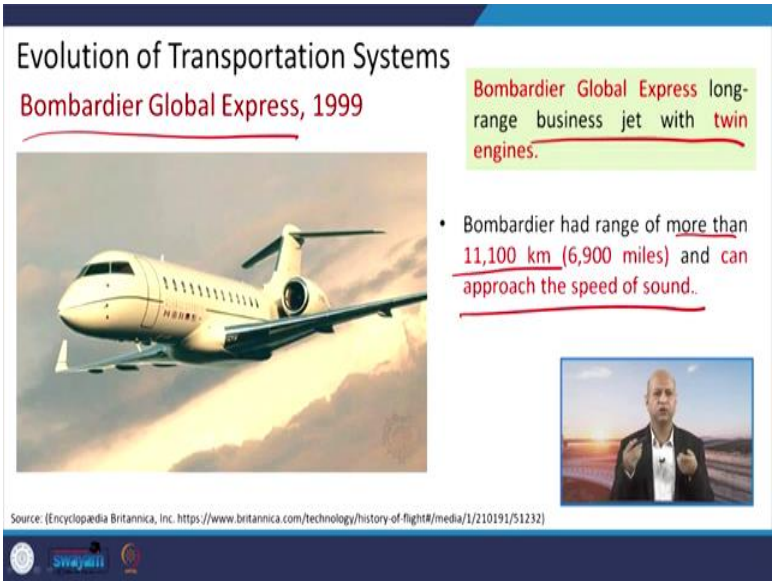

Then this is Bombardier Global Express, 1999. So, this was jet plane with twin engines, and it could had a range of more than 11,000 kilometres and could approach the speed of the sound. So, these ways you can see lot of evolution in air journey took place.

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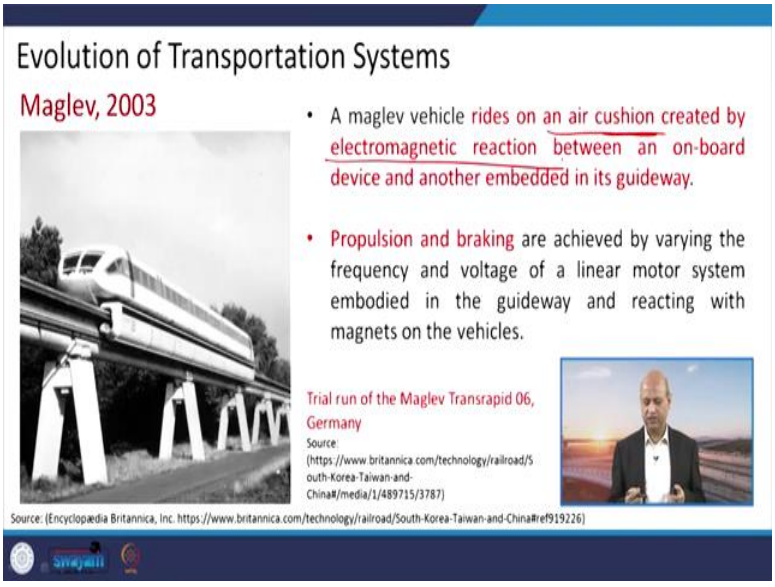

Then this Maglev was there very recently and it can ride on air cushion, so very less friction, very high speed it can achieve because of this electromagnetic reaction and this is going on and bullet trains and very high speed trains were also invented in Japan and Germany and other countries.

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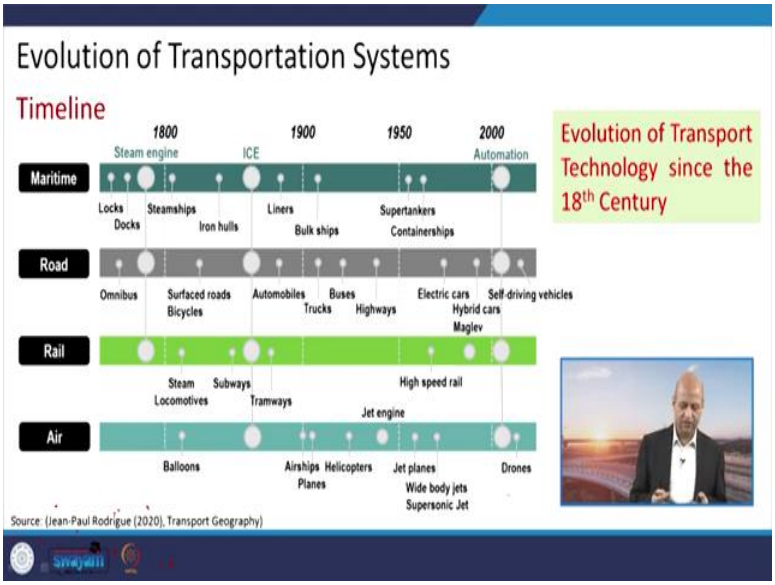

This is the timeline of this transportation systems evolution, you can see in summary, like steam engines, and then the steam locomotive, balloons, maritime road, rail, air, all those transportation systems were together in parallel, I mean, in parallel, they were having evolution. So, from 1800 to 2000, within these two centuries, it was a big revolution.

And that is why we will see later on that, because of this fossil fuel based transportation systems, we also got emissions of air pollution, greenhouse gases, those are the issues that is why this sustainable transportation system course is tackling all those issues, but initially, I wanted to give you this timeline of evolution of transportation systems, how it took place.

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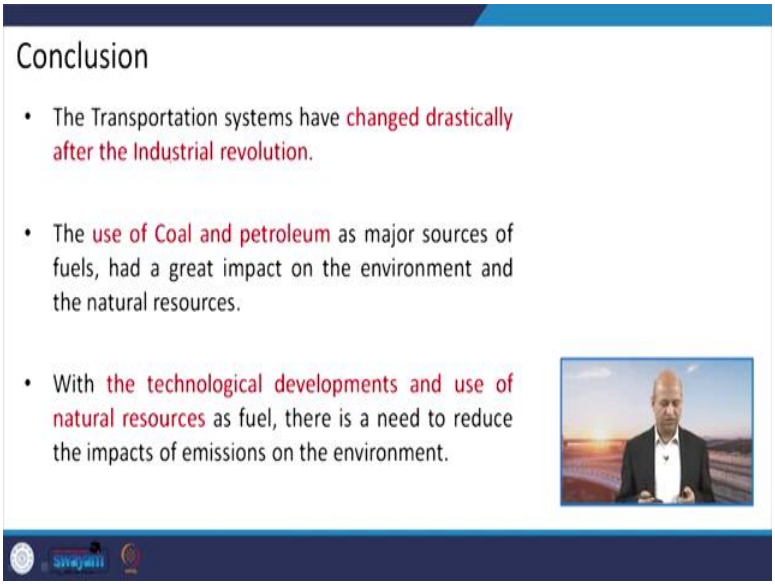

So, in conclusion, we can see that transportation system evolved from very primitive kind of boats and these animal carts, etc. And after Industrial Revolution lot of new things came into existence like railways and then highways or aircrafts, etc. But the usage of fossil fuels like coal and petroleum, gasoline, etc., they gave a lot of air pollution and environmental degradation also occurred, that is why this sustainable transportation systems course is important from that perspective.

And we have to see that these technological developments, which are having negative impacts on the environment, how to address them. So, in this particular course, all those lectures will be surrounding with this theme that how to make them more sustainable, how to evolve that kind of system, which can be sustainable in terms of having very less impact on the environment, and also it is viable, it can serve to the people, it can be accessible. So, those kinds of things will be integrated.

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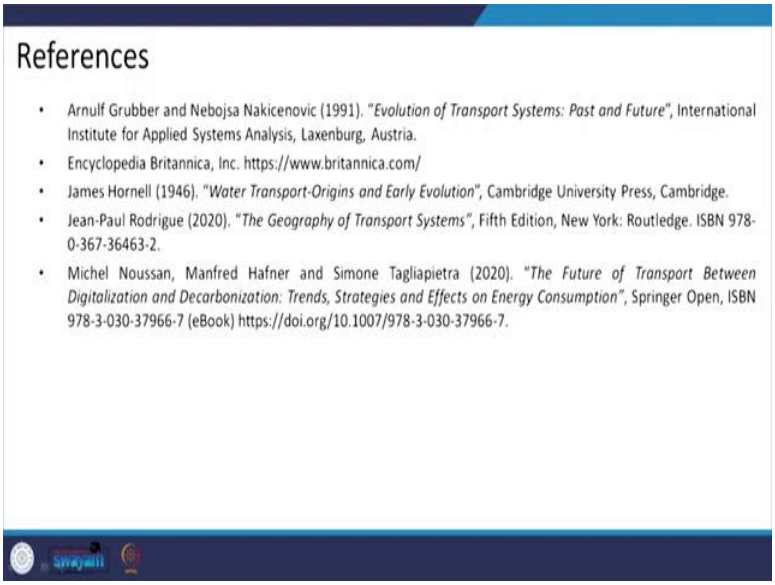

And these are the references which you can go through to have more information about those slides which we have discussed today, so that you can know how these different kind of modes of the transport evolved over the years. And now we have very sophisticated kind of transportation systems in urban centers, in industrial sectors, etc. Thank you very much for today's lecture for your attention, and we will continue through this journey of sustainable transportation system. See you again. Thank you.