**The Elevator Script**

Hi. Good afternoon everybody. Thank you for coming. I’ve still got a bit of a cold. I've got a very stuffed up nose, so hopefully you’ll be able to hear me. And it keeps running as well, so I'll try not to let it run too much during the talk.

Today I want to talk to you for five minutes about the elevator, although I am from England where we say lift rather than elevator, so, if I do occasionally say lift, I mean elevator, and vice versa. Hopefully you’ll understand. OK? Are you ready? Here we go. Five minutes about the elevator in three, two, one, go.

OK. Elevators come from thousands of years ago, of course. People have always managed to pull weights using ropes. Originally elevators would have groups of people pulling a rope over a log, or maybe an animal pulling a rope over a log, which would lift weights. Then the pulley, of course was invented. And what the pulley does is it lets people pull more weight, basically. But, still those were hand drawn elevators.

Then a man called … a Russian man called Ivan Kulibin, in about 1793, he invents something called the screw drive elevator. What a screw drive is, it's a motor with a screw going through it, and as the motor powers, it turns the screw and this can move the motor up or down the static screw. So, a screw drive elevator was basically an elevator … a car … fixed to a screw. And when you press the button, switch the engine on, you could make it go up or make it go down. Now, that was the first kind of motorized elevator. Although, the problem with screw drives are … is they're only as powerful as the motor they use. If you want to lift more weight, you have to use a more powerful motor.

Elevators don't really increase, don't really improve until the Industrial Revolution. Up until then you don't really need elevators. After the Industrial Revolution you suddenly have the need to lift large quantities of coal or wood or metal. You have to lift these in large quantities to the factories, so suddenly elevators become necessary. Loading things on to ships, loading things off ships, moving things … things through factories. So, the development of the elevator starts to take off. Now, in the beginning, of course, we have the steam elevator. This is basically like a modern elevator, but it's motorized by a steam engine. Now, that wasn't bad, but, of course, but the steam cannot produce as much power as a modern electric engine could. So, again, there the elevator is limited by the power of its engine.

Then a man called William Armstrong in 1846, he invents a hydraulic elevator. Hydraulic power is basically … you cannot compress liquid. You can compress a gas, but you cannot compress a liquid. So, a hydraulic motor … a hydraulic system … pushes a hydraulic fluid into a pipe which in turn pushes a piston up, and when you remove the fluid the piston goes down. So, to have the elevator, you push in the fluid, the elevator goes up and you release the fluid, the elevator comes down. And the problem with this, of course, is again, it's only as powerful as the motor. But, also, to lift an elevator ten floors, you have to have a piston that's ten floors high. But to make it go down to the first floor, the piston must then go ten floors down into the ground. So, you have to dig a long shaft, a deep shaft, into the ground, which is obviously a problem.

1850, the modern rope elevator is invented. 1852. Elisha Otis invents the safety elevator. This is a braking system, if the elevator rope breaks, to stop the elevator plummeting to the ground, it has an automatic braking system.

From here onwards elevators improve. You get automatic doors. You get automatic stopping systems. You get basically modern elevators. However, people still do not trust elevators. People would not ride them on their own. Most department stores, any building with an elevator, had an elevator operator. This was a person who basically spent their entire day inside an elevator operating the buttons. These people were in existence until 1947 when they went on strike. And, because they went on strike, people started using elevators on their own, and they began to use elevators. So, these people basically struck themselves out of a job, unfortunately.

Ah. 90 seconds. So, there are some social impacts of the elevator, of course. Once we have the elevator, in about 1870, well, then we get the development of high rise buildings. Up until then, the highest building was about seven floors, because, of course, you cannot walk higher than that. It takes too long to go up a higher building. But, once you have elevators, buildings can start to go up. So, cities stop spreading out, and start growing up.

Also, in about … well since … once the elevator was invented, the price of buildings changes. What do I mean by that? Right now, the most expensive apartment in an apartment block is obviously the top one. The penthouse suite. It has the best views. It's the quietest. But, back before the elevator was invented, the most expensive room was the one on the ground floor because nobody wanted to walk up stairs. So, the ground floor was the most expensive and the top floor was the least expensive because of all the stairs. Once the elevator is invented, this flips over. OK?

Oh. Only a few more seconds. A few interesting things. Obviously they have to test elevators. If you Google it, you can find pictures of elevator testing towers. These are huge towers four, five hundred meters high in the middle of nowhere. And what they do is, of course, they test all the elevators we ride.

Recently you can get double decker elevators, because one of the problems with elevators is …. Sorry. I'm going to carry on anyway. … One of the problems with elevators, of course, is that they fill up. So, recently, you get double decker elevators. So, they stop at floors nine and ten at the same time and they fill on the bottom and at the top. They can carry more people.

Another interesting thing is, right now, when you're waiting for an elevator, of course, you have a row of numbers above the door and a light moves to tell you where the elevator car currently is. If you're waiting on floor three, and you can see it on nine, you can slowly see the number move down. Interestingly enough, people will wait longer if they know where the lift is than if they don't. If you have a wait time of three minutes, if there is no indication of where the elevator is, people will get angry, they will not wait. If you have the exact same three-minute wait time, but you have an indication of where the elevator currently is and how far … how fast it's moving, people will wait much longer. That kind of psychology is actually used by Disneyland in their queuing system. I have a video about that, if you're interested. Have a look later.

OK. Elevator sky lobbies. Most skyscrapers have an elevator sky lobby about halfway up. Elevators are limited of course, by the length of their rope … the length of their cable. The longer the cable, the heavier it is. And, if a cable is too long, it becomes impossible to pull the weight up. So, a very tall building would have a bank of elevators in the middle. You would ride one elevator half way up, you would change elevators, and you would ride another elevator to the top floor. That recently has been changing, of course. The Burj Khalifa, the world's tallest building, currently has one elevator running from the ground to the top. It takes about ninety seconds to travel the whole 828m. That's become possible because recently they don't use steel anymore for these cables. They've started using carbon fiber. Carbon fiber has much more strength than steel and is far far lighter. So, you can have one cable reaching far up into the sky, basically.

Another thing that is happening recently is AI elevators. Artificial intelligence elevators. One of the biggest problems we have with elevators, of course, is they fill up. You’re standing there, the doors open, it's full, “Oh no! I have to catch the next one.” AI elevators. When you're waiting, you swipe an ID card and you press … you input the number of the floor you're going to and the elevator will calculate how many people it's carrying, which floors it's going to, and it will tell you which elevator to catch. For example, if the elevator is going up fast and most people are going to the floor … say floor twenty, and you want to go to floor ten, the elevator will tell you to catch this elevator not this elevator. The elevator will know how many people it's carrying. It will know where they're going, and it will use algorithms to calculate which is the best and fastest, and most economical elevator for you to catch. These are very, very clever. These systems, of course, also know who is in the building. They know how many people have got on and off at which floors so, if there's an emergency, like the 9/11 disaster in America, the elevators can tell the fire service where people are. And the fire service know if they've saved everybody or not. Very, very clever elevators recently.

And, the last thing: space elevators. Not possible at the moment because we don't have a material strong enough to make a chain … a rope … a cable up into space. But, in the future, possibly, we will have space elevators. This will be enabled because centrifugal force will keep a weight at the end of the cable taught as it spins around the earth. And elevators will use climbing motors to go up and down, which would reduce the amount of money it costs to put things in space, which would make space exploration much easier.

Phew. Thank you. I hope you understood that. I'm sorry. I went over my five minutes, probably by about two or three minutes. I'm very sorry about that. Anyway, if you liked this click “like”, it’s down there somewhere. There are questions, answers, and the script and the MP3. The link is down there in the description below. Please have a look. You can read this while you listen. You can also practice the questions, you can practice your reading and your writing. The more you practice, the better your English will get. I hope you've learned something about the elevator. I have lots of other videos about different topics. Have a look. See if you can learn something and hopefully you will improve your English. If you want to get these videos whenever I make them, please subscribe. The subscription link is somewhere down there. It looks like my head. Thank you very much for listening. I will see you again next week. Goodbye.

**The Elevator – Questions**

1. What drove the improvement of elevators?

A: The screw drive

B: The Industrial Revolution

C: The pulley

D: A braking system

2. What is the main problem with a steam driven elevator?

A: It came about because of the Industrial Revolution.

B: It can only work if the steam is very hot.

C: It is very dangerous.

D: It is not as powerful as an electric motor.

3. What physical principal does a hydraulic motor rely on?

A: Force cannot overcome gravity.

B: You cannot compress a liquid.

C: A body at rest has potential energy.

D: The second law of thermodynamics.

4. What is the biggest drawback with hydraulic elevators?

A: They have to have a deep hole for the piston.

B: They don’t work without a large amount of steam.

C: They cannot lift enough coal.

D: They cannot be built near ships.

5. Why did department stores have elevator operators?

A: Because people didn’t want to walk up the stairs.

B: Because elevators didn’t have braking systems.

C: Because elevators couldn’t go high enough.

D: Because people didn’t trust elevators.

6. How did the introduction of elevators affect the layout of cities?

A: Cities spread out much more.

B: People could use more stairs.

C: People started to build higher.

D: Cities started to get smaller.

7. How do the prices of building change due to the elevator?

A: The top floor becomes the most expensive.

B: The bottom floor becomes the most expensive.

C: The prices don’t change.

D: All of the prices are the same.

8. Steven says, “These are huge towers four, five hundred meters high in the middle of nowhere.” Which of these idioms is closest in meaning to “middle of nowhere”?

A: The bottom of the heap

B: The beginning of the end

C: The back of beyond

D: The buck stops here

9. Why are sky lobbies no longer necessary?

A: Because elevator cables can be lighter.

B: Because elevator cables are very long.

C: Because it takes too long to change elevators.

D: Because they take up too much space.

10. Which of these is NOT an advantage of AI elevators?

A: The fire service know who is on which floor.

B: They can predict which floor you will go to.

C: They are more efficient.

D: They are less crowded.

11. The Industrial Revolution spurred the improvement of the elevator. Explain another invention that improved because of the Industrial Revolution.

12. The elevator changed the way our cities are laid out. Can you think of another invention that changed the layout of cities?

13. We take the elevator for granted. Is it ever possible to truly appreciate the labor-saving devices we have?

14. Is it going to be necessary to build taller and taller buildings?

15. What would be the potential advantages of space elevators?

**The Elevator – Answers**

1. B 2. D 3. B 4. A 5. D 6. C 7. A 8. C 9. A 10. B

11. The Industrial Revolution spurred the improvement of the elevator. Explain another invention that improved because of the Industrial Revolution.

 I think that this question is asking for an invention that became necessary owing to the Industrial Revolution, and not something that was a part of the revolution. The elevator became necessary because it was used to shift large quantities of coal and iron ore off ships and to get it onto factory floors, something that became necessary because the coal and the iron were used for other purposes. The elevator wasn’t a part of the revolution, but it became necessary because of the revolution. I think lighting fits this profile.

 Up until the Industrial Revolution, people generally went to bed when the sun set and woke up when it rose. Candles were available, but they didn’t give much light, were a fire risk, smelled bad and were relatively expensive. This is not much of a problem because you don’t do much farming at night. Once the Industrial Revolution happened, people moved to the cities and began to work in factories or down mines. When you work in a factory, you don’t have to be limited by the hours of daylight, and when you are in a mine, well, it is always dark. Thus, a need for lighting arose. The first light were supplied through burning whale oil. Then there were kerosene lights, gas lights, oil lights and finally electric lights. All of these advancements came about because of the need for lighting.

12. The elevator changed the way our cities are laid out. Can you think of another invention that changed the layout of cities?

 I guess the automobile would be an obvious example. it has changed the way our cities have been designed and it will change the way that they are designed in the future. We have always had roads going through our towns. We have always needed to get from point A to point B. In the beginning it was by foot, and then it was by horse and then by horse and carriage. All of these methods require a throughway. So, why is the car any different? When you are walking, or riding a horse, all you need is a road. When you are driving a car, you need somewhere to put it when you finish driving. Over the last century our cities have been reshaped by parking lots and driveways. Cars spend 95% of their time parked. Parking lots cover 40,000km2 in the USA. That works out as 0.4% of the land area. But, when you consider that all of the urban areas in the USA only add up to 2% of the land area, then 25% of every city is for parking! Nothing has shaped our cities like the car.

 And, this is set to change again. We are heading into the era of driverless cars. If you have automatic cars, then you don’t need such wide roads because they can drive more accurately. the cars could constantly move, and people could summon one when necessary, eliminating the need for parking lots. More gardens. More park space. More trees. It’s coming.

13. We take the elevator for granted. Is it ever possible to truly appreciate the labor-saving devices we have?

 There are two ways that we can truly appreciate the labor-saving devices we have. The first is to make a supreme effort and try to remind ourselves each time we use one. This is unlikely because we have so many labor-saving devices these days that we will invariably forget. The second way is to be deprived of them. The old adage that you don’t miss something until it is gone is very true. How much water do you drink every day? Do you get it from your tap? How far is the tap from you? How long does it take to get a glass of cool, clean water? What if the tap broke? You’d go to another room. What if the water was cut off from your house? You’d go to a shop and buy bottled water. What if all the bottled water disappeared? What then? Then you would appreciate the labor-saving device that is a reservoir, water purification plant, pipes, pumps, plumbing, water pressure, a tap and an organizational structure to make it possible.

14. Is it going to be necessary to build taller and taller buildings?

 That will all depend on what the population of the world does. If it continues to increase at current rates, and if the majority of people continue to want to live in urban areas, then yes, we will have to continue building up.

 Our land space is not infinite. If the population of the world keeps increasing, then we will need more and more space for agricultural land. Assuming technology doesn’t find a way of growing more in less space. That means that the amount of space we have to live an work on will decrease. In that situation, the only way is up. With the new carbon fiber elevator cables that Steven talks about, buildings can be taller and quickly serviced by elevators. However, there are problems with building taller and taller buildings. The first problem is the structure itself. Buildings are largely air, so they are lighter than solid objects, but they do still need to have a wide base to support large tower. The second problem would be the number of elevators you would need and the length of time it would take you to get to the top. Then, of course, there is the cost. The Burj Khalifa cost $1.5 billion. Would a tower twice as high cost twice as much? And, presumably, if you do manage to build a tower that stretches into the sky, you would have to think about the lack of oxygen. The top of Everest is in the Death Zone. This is the area where there isn’t enough oxygen to stay alive for a very long period of time. How would a building taller than Everest deal with that problem? “Oh, Johnson. I wasn’t very happy with that report you made last week. I think I’m going to have to ask you to go staple all of these documents on floor 1624.” “But, Sir, that’s the… Death Zone.” “I know, Johnson. I know.”

15. What would be the potential advantages of space elevators?

 The main advantage will be that it increases our ability to explore space. It would be extremely difficult to build any kind of interstellar spaceship here on Earth and then launch it into space. Gravity is too strong, and it would need so much power and fuel to get out of our atmosphere that it wouldn’t be practical. The only way to build something large enough would be to construct it in space, say at the International Space Station. However, to get the building materials into space is ludicrously expensive. It costs $22,000 to put 1kg in space. The unloaded space shuttle weighs 75,000kg. To build something as small as that in space would cost $1.65 billion. And that’s just the cost to launch the parts to the space station. Think of that as $1.65 billion postage and packing. Space X and other companies are making reusable rockets, which will bring the price down, but it will still be expensive. A space elevator would offer a cheap way of getting things into space. As it would run on electricity, not rocket fuel, it would cost about $200 to get a kg into space. Space travel would become cheaper and would increase rapidly.

 Before a space elevator is possible, a number of problems need to be overcome. One of the biggest problems is making a long enough, strong enough and light enough cable. The cable would have to reach geostationary orbit which is 35,786km. Carbon nanotubes are a possibility. They are light, very strong and also conduct electricity. However, we can currently only make them as long as about 20cm. But, the time will come.