

EVERYDAY WONDERS



Laura A. Large

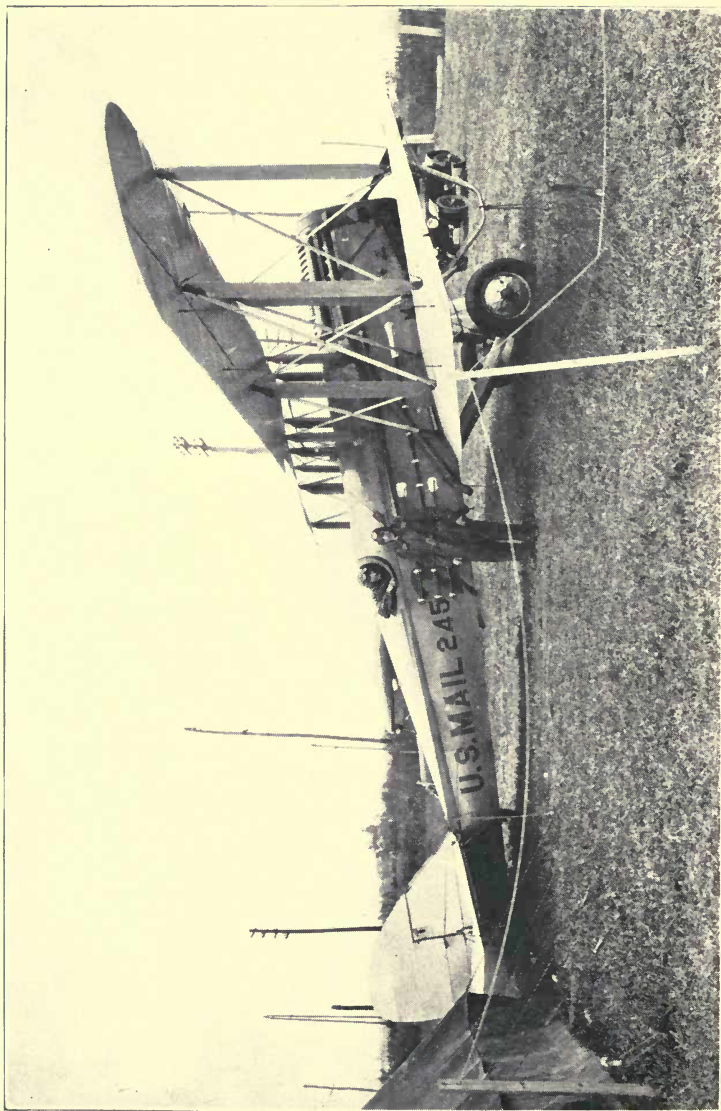
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EVERYDAY WONDERS



MAIL PLANE OUTFITTED WITH WIRELESS

Everyday Wonders

By

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*Author of "Little People Who Became Great,"
"Little Stories of a Big Country"*

ILLUSTRATED BY PHOTOGRAPHS



W. A. WILDE COMPANY

BOSTON

CHICAGO

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INTRODUCTION

THE boys and girls of to-day are living in an age of wonders. They may telephone to their friends, ride in a fast-moving steamship, or listen to strange voices that are carried through the air by radio.

Many children are used to these privileges and do not think of them as wonders. A few may even suppose that the people who lived in long-ago days had the use of the same great inventions which are in use to-day.

Boys and girls who read this book will know when many of the great inventions were first given to the world and how hard it was to work them out.

When they have read the book they will know that some of the inventions of to-day are wonders of the age although in use everywhere.

And who can tell but that some of the children who read this book may be the inventors of a future day? If this is true, we shall hope they may have

occasion to remember with profit some of the experiences of the great inventors about whom they once read in the book of "Everyday Wonders."

It is fortunate that we can illustrate these stories with such splendid pictures and we are all indebted to the following companies who have permitted us to use some of their copyrighted photographs.

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Everyday Wonders

SHIPS THAT SAIL IN THE AIR

A CROWD of people were gathered in the public square of a little village in France one day. "We have a surprise for you," two wealthy brothers of the town had said when they gave out the invitations.

The people were eager to see what was in store for them. "What can the great surprise be?" many asked.

Every one watched with interest while a great linen bag was brought to the square. It hung from a rope like a huge limp sail. There was a large round opening at the base of this bag, and about it the parts of the linen were sewed fast to a wooden ring. Beneath the ring was a pit, into which men

had put straw, wood, and chopped wool to use in making a bonfire.

“Ready!” shouted one of the brothers. The other brother lighted the fuel with a torch and in a moment flames shot upward. A thick cloud of smoke arose too. The bag began to spread out in all directions as it filled with gas and smoke. Then it took the shape of a great ball that pulled and tugged at the ropes that were trying to hold it. The keepers let go and the globe arose into the air like a live creature. Up, up, higher and higher it went, while the people below clapped their hands and shouted.

The balloon went so high it was soon hidden behind a patch of cloud. Then it appeared again. The people could see it rising until it reached a place in the heavens over a mile above the earth.

Every one shouted so loud the noise was deafening. Some men tossed their hats into the air, the children danced about, while the women all started to talk at once because they were so excited.

Some farmers were working in the fields about

two miles from the spot where the balloon was launched. They did not know what had been going on in the public square of the French town. They did not even know that the brothers had promised a surprise for the people.

While they were at work, the great black balloon appeared in the sky and slowly began to come down to earth. The humble farmers thought that the Evil One was after them. They rushed at the balloon with their pitchforks and scythes! "*The Evil One! We will destroy him!*" they shouted. As the balloon gently struck the ground, they rushed at it, making holes and gashes in the linen covering.

You know what happens to a balloon when just one hole is made in it. With many holes and gashes the great linen bag was once again limp, and it was torn into shreds besides. Some of the farmers tied it fast to a horse's tail and the frightened creature galloped with it into the open country.

This was the first balloon that had ever really sailed into the heavens. It was called the *Montgolfier* balloon because it was made by the Montgolfier

brothers. This first balloon could stay up in the air only a little more than ten minutes. The reason for this was the way in which the linen covering was made. It had small openings here and there through which the gas escaped little by little.

But people knew that a way had at last been found to make a ship sail in the air, and this made them very happy. More than this, it set men to thinking. They began to try to make ships that could sail about in the air for a longer time, and it was not long before it was found possible to do this.

Even then men did not stop working, for they were not satisfied. The balloons were at the mercy of the wind, which could blow them any way it chose. What men wanted was to be able to make their way through the air wherever they might wish to go. They wanted to fly like birds.

For many years men had wanted to do this. After the first balloon had been made, they tried harder than ever to learn to fly with make-believe wings.

One German man named Lilienthal came nearer

to doing this than any of the others. He studied the wings of birds and watched the young birds fly. Then he made himself a pair of wings and tried to learn to fly too.

Perhaps you can tell what troubles he had when he tried to do this. Birds are made for flying and can balance themselves with great ease. They are small too, and can lift themselves high up into the air with little trouble. With men it is different. They were not made to fly, and they are so big and heavy that it takes a good deal of power for them to be able to make their way through air.

Lilienthal faced toward the wind just as he had seen the young birds do when they were learning to fly. Then he ran fast and turned his make-believe wings up to catch the wind. He thought that he would surely fly, but he was only raised from the ground a short distance. It pleased him to be able to do even this much, but he knew that he must have more power. He had a hill made, with a long slope. He climbed to the top of the hill and tried to glide on his wings down into the valley below.

It took him a long time to learn to do this without falling to the ground or turning over backwards. People gathered to see the "flying man" hanging through the wooden loop that held the two wings together. Some were almost afraid to watch him. "He will fall! How does he dare to go through the air like that?" some of the men cried. Every one thought Lilienthal a very brave man, which he truly was.

The more he glided, the more he enjoyed it, and the more risks he took. He wanted to be able to fly high in the air and to stay up for a long time. In trying to do this he forgot his own safety. One day he lost his balance while gliding along, and fell to the ground with great force.

The "flying man" was killed instantly but he was not forgotten. People began to study the birds for help in learning to fly, just as Lilienthal had done. They learned a great deal about shaping the wings and about placing them so that they might best catch the wind. They learned that man was never made to fly like a bird. He must have

a ship in which to ride, and this ship must have wings and a tail to help move it.

Finally, two American brothers made the first ship that could be guided through the air. The brothers were named Wilbur and Orville Wright, and they called their ship an aëroplane. They called it a biplane too, because it had two wings, or planes. One very good thing about it was the gasoline motor which gave it the power to force its way through the air wherever the pilot or guide might choose to send it.

Other men set to work on different kinds of aëroplanes, and to-day there are thousands of them in use all over the world. Some men made monoplanes, which are aëroplanes which have one plane or wing instead of two. A Frenchman made one called the *Antoinette* that looked like a great bird from a distance. People always admired it for its beauty and for its swift flight.

To-day aëroplanes are used a great deal. It may be that some child who reads this story has had a ride in one. A boy who lives in New York was

brave enough to ride in one not long ago. He said he felt as if he were riding on a big feather, but he was not a bit afraid.

Most children would like to go high above the earth and look down upon the trees and upon the roofs of houses. They might even enjoy going through the clouds too. This is where aëroplanes sometimes turn upside down, because it is hard for the pilot to balance the ship with nothing but clouds about him.

The roar of the motor might seem loud to some children, but one soon gets used to this. Most grown-ups think it is a good thing if the engine is working well enough to make a loud noise. One danger is that the motor may get out of order and stop while the ship is high in the air. Then the pilot must balance the aëroplane carefully and try to steer to the ground in safety. Sometimes he is able to do this, but often he makes a rough landing, which gives him a good shaking whether he deserves it or not. Most people would rather land without the shaking.

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Pilots who have been riding in aëroplanes for a long while become used to this kind of travel. Some like to fly for exhibitions. They loop the loop in the air. They dive this way and that way. They fly upside down or upon the sides of their aëroplanes. Sometimes they write in the air with the black plume of smoke from their engines.

People gather by the thousands to see these exhibitions. They like the speed races and the climbing races too. In New York the pilot of an aëroplane won a prize by making his ship go through the air as fast as two hundred and sixty-six miles an hour. This is ever so much faster than the fastest train in the world, and faster than the fastest racing automobile.

Not all aëroplanes travel so fast, and not all are used for exhibitions. Some are used to carry passengers, and many carry mail. Between Washington and New York, Cleveland and Chicago, and as far west as San Francisco mail is carried in this way, because it saves time. In the cold northern

countries this is especially true. In Alaska mail can be carried ever so much more quickly through the air than upon dog sledges.

One of the fastest mail-carrying aëroplanes of the United States travels eighty-five miles an hour and carries fifteen hundred pounds of mail. Since it takes forty-two letters to make up a pound, this mail aëroplane has a carrying power of sixty-three thousand letters!

These mail aëroplanes are of more use than the carrying of mail. They are helping to show the people of the country that air routes can be made just as railroad routes by land.

Each year the United States Government is making the aëroplane mail service better in every way. The men who run the machines have been taught to send wireless messages whenever they wish to speak to people on land, and they receive replies by radio. They are being taught to study the weather so that they can guide the aëroplanes more wisely. It makes a difference to the pilot of an aëroplane how much the wind will be blowing at a certain alti-

tude. Snow and extreme cold in winter call for special planning.

In the World War aëroplanes were of great use in carrying messages from one officer to another. And, more than this, they were the eyes of the army. They darted here and there above the enemy's trenches and marching armies, and then back again to their own lines to tell what they had seen. Sometimes they stopped long enough to bring down one of the enemy's aëroplanes. "Putting out one of the eyes of the enemy," is what the pilot would report that he had done. At other times bombs were dropped upon depots containing supplies, or upon bridges. An aëroplane pilot who could bring down five of the enemy's ships was called an ace. Many brave men won this name for themselves.

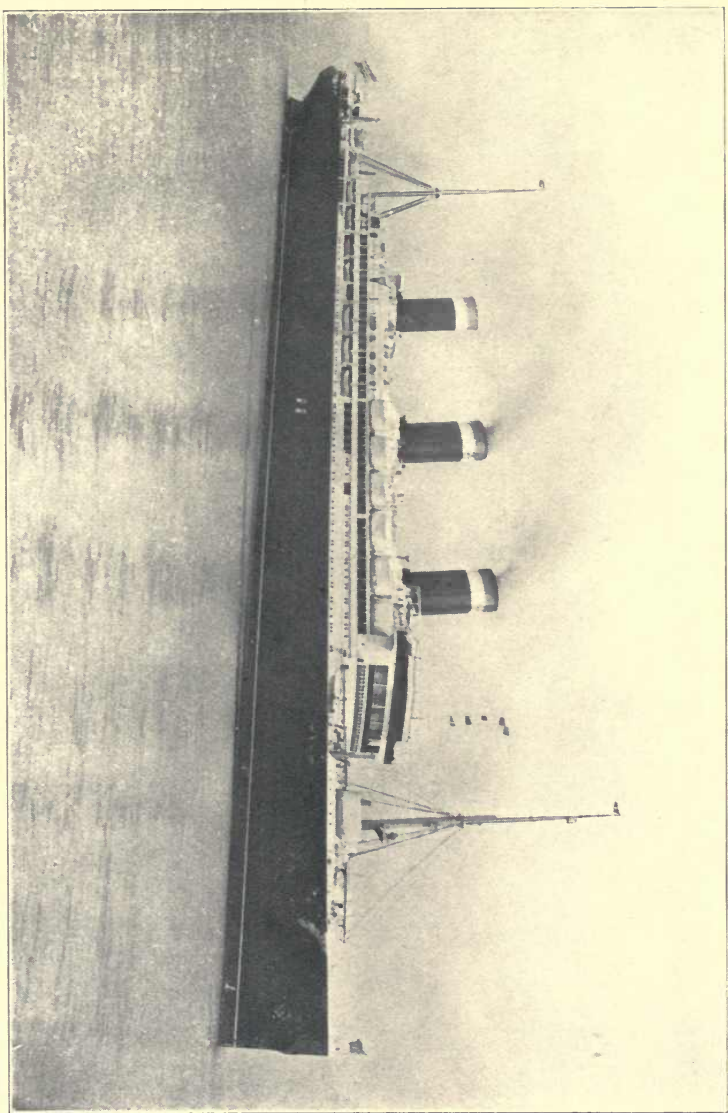
Changes are being made each year in aëroplanes, and in balloons too. Some of the balloons are so large that many passengers can be carried with safety. Some day there will be balloons to carry loads of passengers over the great Atlantic Ocean from New York to Liverpool.

One swift aëroplane carried two men across the Atlantic Ocean a few years ago. It took them less than a day to make the trip in this way. A steamship would have taken a week. The men were trying to win a prize when they made this trip. They went through great dangers, but they learned many things about travelling a long distance in an aëroplane.

The pilots had two black cats named Lucky Jim and Twinkletoe. The men called them mascots, which means that the cats were to try to keep the men from harm. If this is true, the mascots did their work well. The two pilots arrived in Ireland in good shape, and were treated kindly everywhere because of their bravery.

Some day your great-grandchildren may have wonderful stories to tell about the aëroplane. These new machines may then be used as much as automobiles are now used for work and pleasure. And how strange it would be if the children were given small aëroplanes for Christmas instead of velocipedes and bicycles!

"S. S. LEVIATHAN" ARRIVES AFTER BREAKING RECORDS FOR OCEAN GOING LINERS



A PALACE THAT FLOATS ON THE WATER

YOU have read in your fairy-story books of the wonderful palaces in which the fairy kings live with their sons and daughters. Every child would like to live in one of these palaces with its carpets of gold, its hangings of silver, and its walls of candy or sugar. These palaces are never visited by real children, nor are children allowed to spend much time within the palaces of kings who live in our world. Children would not even dare to make such a visit. "Go away from here," they would expect the man at the door to say.

One palace has been seen and visited by thousands of children. It is not a fairy palace. It is not the home of a king or queen of any kind. It is found floating upon the water—a great steamship which is called a palace because the furnishings are so rich and beautiful.

If you were to enter a salon of one of these large boats, you would be glad if you were neat and clean because this room would be one of the most richly furnished rooms you had ever seen. A boy who had mud on his shoes would never care to walk across the carpets of this room. They are of soft velvet, and the chairs and couches are covered with soft rich velvet too.

In the restaurant on the boat the tables are spread with white covers, and the dishes and glassware are bright and sparkling. Dinner hour on one of the great steamships is always a favorite time, for there is sure to be something that children like to eat. Chicken, ice-cream, fruit, and cake are served often. If three meals aren't enough in one day, one may get a glass of milk, a sandwich, or candy at any time. Down in the lower part of the boat there are tons of beef, and thousands of chickens ready to boil or roast. There are tons of flour, fruit, and vegetables, and hundreds of gallons of ice-cream. Some children who see this great store of food may think that a part of it will have to go to waste, but

very little is unused. There are hundreds, sometimes thousands, of passengers on board the ship, and the cool ocean breezes give people hearty appetites.

Most children like the bedrooms. These are always clean and fresh looking, and there is an electric light within easy reach. If a child wishes a light in his room at night, he can turn on the electricity without even getting up from his bed. In most of the bedrooms there are fans that keep the cool sea air moving about in summer. In winter the air is warmed before it is forced into the room.

Out on the decks there are comfortable chairs in which people may rest as they look out upon the ocean waters.

Children who like to jump and climb about can have great fun in the gymnasium. Some of the boats have hobby horses that are moved by electricity, and most of them have trapezes and ladders. There are ropes for climbing, and even rubber balls of different sizes. For children who like to be in the water there is a swimming pool, and at times

there are races which the children always like. One child learned about the potato race for the first time while crossing the ocean on one of the big boats, and the wheelbarrow races have been new to many children.

Then there is the music room with its piano and orchestra. Every one is pleased when the musicians play "The Star-Spangled Banner" or some other song that all can sing.

Children who like to read will find books of all kinds in the library. This room is so cozy that one feels as if he were reading in his own home, although there may be miles of deep sea between him and that very pleasant spot.

There is even a barber shop where many children sit up in the big high chairs and get their hair cut just as if they were in a barber shop on land.

Men who like to smoke can go to a smoking room or out upon one of the decks. People who like a view of flowers as they look out upon the water will enjoy one of the garden lounges from which there is always a good view of the ocean. Handsome

paintings upon the walls make some of the inside rooms pleasant places in which to read or talk with friends. There are desks here and there about the boat too, so that one may be comfortable while writing a letter to a friend.

Most of the boat palaces are large enough to allow many people to travel at a time. The *Aquitania* is one of the largest. If it were to be set up on end, it would reach into the sky higher than the Woolworth Building in New York. A train of eight cars with its large engine and tender could rest upon the upper deck of this great boat alongside the four huge funnels. The electric plant in the vessel is large enough to furnish light to a town of two hundred thousand people, which is larger than the towns in which live many of the children who may read this book. The furnaces and boilers of the *Aquitania* furnish enough steam to heat the houses of a small town. There are twenty-one boilers which weigh two hundred tons each, and there are one hundred and sixty-eight furnaces. When the boat is carrying as many pas-

sengers as she can, there will be four thousand people on board. A great number of towns in the world are no larger than this.

With so many people, the boats must be made very safe. Most of the big ships have powerful radio machinery, which can be used to call for help at any time, and there are strong rowboats as well as motor life-boats. The ships have electric fire-alarm systems and are well supplied with chemicals that can be used to put out fires. The sides and bottoms of parts of the great vessels are made up of two shells, an inner and an outer shell. These are both water-tight. Some of the largest boats have tanks that help to keep the ship steady in times of heavy storms at sea.

A few people who do not know a great deal about the big steamships are afraid to travel in them. People who have learned about them are not afraid. They know that most of the great ocean steamers can carry them more safely than a railroad train or an automobile. Ocean travelling is healthy too. When you have played a game of tennis or raced

upon a deck that is being fanned by cool sea breezes, you are ready for a hearty meal or a good sleep at night. Sick people often get well before they have been upon the water many days.

As you have seen, the palace that floats upon the water is like a king's palace about which most children have read. Both are beautiful. They are made to furnish comfort too. But not all the steamships of to-day are like palaces, and it is only within the last few years that there have been any at all.

Years and years ago the only boats men had were the logs which floated down the streams. Men balanced themselves upon these and were carried along for short distances. After a while they fastened several logs together to make a raft. Then logs were hollowed out to make crude boats, although these were too heavy to be of great use. The boats weighed so much the men could carry but little in them.

The birch-bark canoes that were made later were more useful. These were made of the bark of the birch tree, and were so light that three tons of furs

could be hauled in one of them at a time. The Indians were the first people to make this kind of boat. They used the bark of the birch tree stretched over a frame of red cedar. They stripped the bark from the tree in one large piece and sewed the parts together with the roots of the spruce tree. Gum of the pine tree was used for glue. The boats were not very strong, and the men who rode in them had to carry fresh strips of bark, pieces of spruce root, and bits of pine gum so that repairs might be made quickly should the thin bark be torn.

People were contented with these boats for a while, but they soon wanted to be able to go faster and to travel more safely through the water. A heavily laden birch-bark canoe could be made to go little more than four or five miles an hour. Children whose parents have automobiles know how slow this is. Most automobiles go as slowly as four miles an hour only when they are getting started, or when going along busy streets where there are many automobiles, cars, and wagons in line. It was no wonder that, as time went on, people set

about making boats that could travel more quickly in safety.

For a while wooden boats were used. These were stronger and safer than canoes, but could not be made to go fast enough, and it was hard to row or paddle them through the water.

Men soon got the idea of letting the wind help to move their boats. The sailing vessel was then put into use. The first sailboats could carry sixty tons instead of three or four tons carried by the canoes and bateaux. They could go faster than any of the boats that had been used, and they were safer. Even hostile Indians were not to be feared by the men in these sailboats, because large guns and cannons could be carried by the sailors.

It was a sailing vessel which carried Christopher Columbus from the shores of Europe to American soil, as you know. Columbus rode in this kind of ship because it was the best there was at that time. It took him two months to reach the new land which he discovered, and there were few comforts on board the ship in which he sailed. If he had

ever ridden upon a fast-moving, comfortable steamboat, such as we have to-day, he would never have chosen a sailing vessel in which to make his trip.

In the time of Christopher Columbus no steamboats were in use in the whole world. It was more than three hundred years later that Robert Fulton worked out his plans for a steamboat and put the first one into use.

From that time on, the boats began to be made larger and better in every way, although for a long time not any of them could have been called a palace. It was only after the power of steam had been used for a long time that the very large and beautifully furnished boats began to be made.

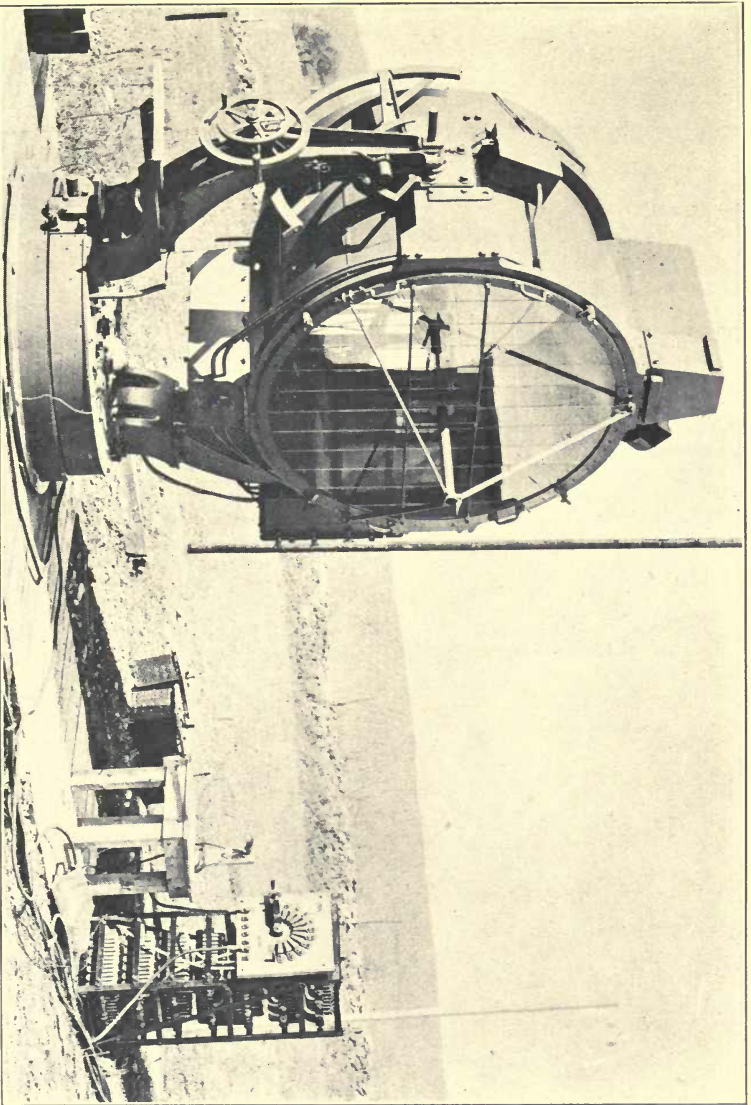
The boats of to-day can travel ever so much faster than the early boats too. "Walks-in-water" an Indian said when he saw Robert Fulton's first boat making its way up the Hudson River. "Runs-in-water" this Indian might say if he could see the boats of to-day. When the first steamboat moved up the Hudson River, the farmers who stood upon the banks were almost frightened. They thought

Robert Fulton's *Clermont* a very strange boat. It had a cloud of smoke over it by day. At night the sky above was lighted by the fire of its engines.

The people did not know what a great and wonderful power was being put into use in this boat made by Robert Fulton. They did not know that some day this wonderful power could be made to do greater things. It took Robert Fulton thirty-two hours to go from New York to Albany in the *Clermont*. In one of the boats of to-day this same trip can be made in nine and a half hours. One of the Hudson River boats called the *Hendrick Hudson* carries as many as five thousand passengers while making the trip.

Every year thousands and thousands of people make the trip across the ocean in comfort because of the great boats that are run by steam. Each ship-owner wants a large number of passengers on his boat, and for this reason the ships are made as beautiful and as comfortable as the owner can afford. If one steamship company adds a new luxury to what it has to offer the passengers, other companies

know that they too must do more for the people. In this way the boats have been getting more and more luxurious until we have to-day the great steamships that are like the homes of kings and princes.



The World's Largest Searchlight
It is to be the Liberty Light of the Golden Gate, to be installed on Mount Tamalpais near San Francisco, California

A LIGHT THAT CANNOT BE BLOWN OUT

MANY thousands of years before you came to live upon this earth there lived a strange race called prehistoric men.

A prehistoric man happened to rub his thick skin robe with a piece of amber one day. He was surprised to see that sparks came from the amber. His friends rubbed their garments with the stone, and they too could see the same kind of sparks. A little later they noticed that the amber stone could be made to pick up pieces of thread or small objects. The prehistoric men were not wise enough to know what caused the amber to do these things. They thought that the stone was magic, and many of the people were afraid of it.

After many years people found that when they rubbed a piece of glass rod with silk or leather,

bright little sparks would appear. When they rubbed catskin over hard rubber, the same sparks were seen.

By this time people were no longer afraid of these sights. They called the sparks electricity, and they became interested in looking for other signs of the strange power.

Still later, when Benjamin Franklin grew to be a man, he got to thinking about the lightning that was often seen in the sky. He said: "I believe that the lightning is electricity. I think that I can make some of it come down to the earth."

The people thought this a very dangerous thing to do. "Do not risk your life," many of them said.

Benjamin Franklin knew that there was danger in trying to work with lightning, but he felt that he knew a way to make the work safe enough to try. He made a kite of silk, and to one end he fastened an iron point. To the other end of the kite he fastened a string. The upper part of this string was of twine but the lower part was of silk. Just between the twine and the silk he attached a key.

When the thunder began to sound in the heavens, Benjamin Franklin went out into the country to let the kite fly. At first there were no signs of electricity, but in a short time he noticed the loose fibres of the string begin to bristle and he held his knuckles to the key. As he did this, bright sparks could be plainly seen. Rain began to fall, and soon many large sparks could be drawn from the key. Franklin knew then that lightning was really electricity in the sky, and that it could be made to come down to the earth.

After this, men found that there is electricity in the air even when there is no thunderstorm. Then they began to find out how to use this great power. They found that although it could not be seen and was very quiet, it could be made to do a great deal of work. Soon they discovered that it could be made to run along wires and go wherever they wished it to go. They learned that it likes its home very, very well. If a current of electricity is sent along a wire from a certain place, it will return to that place as fast as it can, if there is another wire

to carry it back. The electricity is so eager to get back home that it will push along as fast as it can. This is why men can make it do so much work for them.

If a man wishes a stove heated, he will make it hard for the electricity to push through the wires that are in the stove. The electricity will want to get back home quickly. It will push through the wires so hard that heat will be produced. Stoves for cooking and for warming cars are heated in this way.

Electric irons are heated in much the same manner. No doubt your mother is glad that electricity will heat her iron for her. There was a time when irons had to be placed upon a hot stove in order to become heated, and much time and strength were lost in going back and forth with them. Besides this, they would be very hot at one time and cool at another. With electricity the heat can be kept more even.

Some women have curling irons that are heated by electricity. Coffee percolators may be heated

in the same way. One can make coffee while seated at the breakfast table when an electric percolator is used.

Electricity is used for ringing door-bells, while trains run by it are found in many parts of the country. These trains are much cleaner than those run by a steam engine which sends out great clouds of black smoke.

What electricity does for us by means of the telephone and the telegraph is very well known. Some boys have telegraph sets of their own, and can tell just how electricity is used in this way. How it helps to make our radio sets of use is understood by many boys and girls.

Most children do not know much about electric furnaces, but their fathers can tell about the work that these do. With electric furnaces a very strong heat can be made. This is used to act upon metals that could not be used unless they were changed by the action of heat. Aluminum is made in this way. When your mother cooks your oat-meal or cream of wheat for breakfast it may be

that she uses a double boiler made of this very useful and lasting material. Perhaps she fries bacon in an aluminum frying pan.

And what boy has not owned a flash light of some kind? These are made in many shapes and sizes, and can be bought for a small amount of money. Some boys have had a vest-pocket flash light which is so small that it can be carried in a pocket or in a lady's pocketbook. One has but to press a button to get a beam of light that is bright enough for many uses. For Boy Scouts or other campers this kind of flash light is very handy to own. Campers are often awakened in the darkest part of the night by strange noises. If it is in a part of the country where there are bears and wolves, a boy is glad to be able to light up his tent quickly.

Some flash lights are made to give colored lights that can be used for signalling. Boy Scouts also make use of these at times. Some people like to use a flash light when they wish to see the face of a clock at night or find a keyhole in the dark.

Almost any child could name other ways in which the wonderful power of electricity is used. Most boys know how it can be made to come from different kinds of batteries. A few can tell how it is made by means of a dynamo. Trains and boats are run by electricity coming from this source.

Many children know how to rub electricity into a newspaper. They lay a strip of newspaper flat upon a table and hold it down firmly at one end. Then they rub the paper rapidly with the finger nails of their free hand. When they try to take up the paper, the electricity which they have made causes it to stick to the table almost as if it were pasted there.

It is just as easy to make a glass rod pick up bits of thread or paper, just as the men who lived thousands of years ago were able to do. One has only to rub a glass rod or a stick of sealing wax with a silk handkerchief and hold one end near some bits of paper. These will fly up as if there were an unseen force pulling them toward the glass rod or the sealing wax. The kind of electricity at

work upon the paper is most easily made in dry weather and during the winter months. No doubt some of you have found out about this.

Perhaps the most useful work that electricity does is to furnish light. Before the electric light came into use people used candles, kerosene lamps, or gas. As you know, the electric light is ever so much better. It is safer too. No matches are needed to make the light. When gas or kerosene is burned, the air is made impure, and there is more heat than when an electric light is used. And the electric light cannot be blown out while the glass bulb around it remains unbroken. Blow as hard as you can upon the electric-light bulb in your bedroom to-night and see if you can blow out the light. You will find that this cannot be done, although you may be able to blow very hard.

Years ago there were no electric lights, but there was a clever man in the country who knew more about electricity than any other man. Thomas Edison was his name.

Mr. Edison said: "Electricity is a wonder

worker. It can be made to light our lamps for us."

"This would be a great comfort," men thought, but few of them believed that a way could be found to bring about this great change in lighting.

Thomas Edison had to work hard to do what he had said could be done. He even sent men to Japan and South America, who brought back with them thousands of different kinds of plant stems. Mr. Edison wanted to use one of these to make a fine thread to put inside the electric-light bulb. He wanted the thread to be very strong and hard for the electricity to push through. He knew then that it would have to push so hard that the thread would become heated and light would be made to shine.

After working a long time Mr. Edison at last found the right kind of fibre thread to use. He was then able to make the "incandescent light" that we have to-day. *Incandescent* is a long word which means "heated to a white glow." If the light in your bulb is not too bright for you to see

clearly, you will notice that it does glow with a white light.

Besides the incandescent light Mr. Edison made arc lights too. These are strong and bright and are used for engines, for lighting streets or large halls, and wherever a powerful search-light is needed. They are found often on top of the pilot house on a ship, while in war time many ships find these powerful search-lights very useful. Steam and electric locomotives as well as interurban cars use the arc lamp for a headlight too.

The incandescent light is better than the arc light for home use because it has a softer glow and is less glaring. Thousands and thousands of the incandescent lights are in use all over the country.

If a prehistoric man could see the electric light that we have to-day, he would surely run away from it at first. "Magic! Magic!" he would cry. Then it may be that he would fall upon his knees and worship the light because it would seem like some kind of a mighty power or hidden spirit.

Not even the smallest children of to-day are

afraid of the electric light. The older children find it very useful when they are doing their home work in arithmetic or spelling, or when they are reading a story at bedtime. It would be hard to find any one who is not glad that electricity has been made to furnish light for us.

A SILENT HELPER IN DEEP WATERS

UPON a lonely rock off the northeast coast of England there stands a lighthouse in the midst of deep sea waters. For many years the light from its tower has shone far out upon the sea in a friendly way. "Be careful in these waters. There are dangerous rocks about," the friendly light seems to say. Year after year the quiet lighthouse stands ready to warn any sailors that may come near the treacherous waters. Hundreds of lives have been saved and many valuable ships have been saved from destruction because of this lighthouse helper.

A family of three once lived in the lighthouse to keep it in good order and to watch the light in the tower. There was the father. Mr. Darling was his name. There was the mother. And there was the daughter, Grace.

When the waters were stormy Mr. Darling



A SILENT HELPER IN DEEP WATERS
MINOT'S LEDGE LIGHT STATION, MASSACHUSETTS

would not leave the light alone by day or by night. He knew that he must be on watch so that the lighthouse might do its work well. He was a faithful lighthouse keeper. Not only this. He taught his daughter to be brave and ready to do her part.

It was well that Grace Darling had been taught to be brave, for there were dangers all about her lighthouse home. The sea waters became very angry at times, and they beat against the rock as if they meant to wash it away or dash it into pieces.

One night a terrible storm came up. The sea roared and the waves beat upon the rock with a mighty force. The cold waters of the northern sea leaped into the air. There seemed to be water everywhere.

The lighthouse stood silent but firm in the midst of the terrible storm. It seemed to be trying to make the friendly beams of its tower light reach farther than ever across the waters.

Mr. Darling, the lighthouse keeper, and his daughter, Grace, were awake and on the lookout for some one who might be in trouble.

“ I do hope no ships try to pass through these waters to-night,” Grace and her father must have thought as they heard the roaring sounds all about them. “ The rocks are dangerous enough in fair weather, but in a storm like this it would go hard with even the best of ships.”

From time to time the keeper and his daughter looked through the big marine glasses to see if there were any ships in sight. For a long while nothing could be seen but the dark shadowy waters lighted by the rays that came from the lighthouse tower.

Grace Darling was about to leave her father for the night when she gave a cry, for she had caught sight of a ship. Not a strong sturdy ship plowing its way through the waves! It was a poor wrecked vessel that had broken in two upon one of the big rocks.

Grace Darling almost shouted. “ A wreck! A wreck!” she cried. She looked through the glasses eagerly. “ People are clinging to the ship. They will drown! Father! Father! What shall we do?”

she cried. "We must save them! We must save them!"

Mr. Darling was dismayed at the terrible sight, and alarmed at the thought of launching a rescue boat at such a time. He knew that he could not row a boat alone upon such a sea, and he hated the thought of allowing his only daughter to risk her life.

Grace Darling was not afraid. "I will go with you. You must let me go!" she cried.

There was no time to lose. Mr. Darling gave his daughter an oar and he himself took one. Upon the racing waters they launched their boat. They forgot about their own danger, so eager were they to rescue the people who would surely be lost if help did not come quickly.

After the hardest struggle that Grace Darling or her father had ever known, the little boat reached the spot where the people were clinging to the pieces of the broken vessel. There were eight men and one woman.

Even then Grace Darling and her father did not

think of their own danger. They took four of the men and the one woman first. Then they returned to the wrecked boat a second time for the four men who were left. It takes but a short time to tell of it, but it was a terrible task. The little boat almost upset many times, and Mr. Darling and his daughter were panting from the hard work of pushing it through the rough waters. Grace Darling was drenched to the skin and numb with the cold long before she reached the lighthouse the second time. She was faint too, and could scarcely stand when she left the boat.

But there was a happy crowd in the lighthouse that night. One of the rescued men told how the lighthouse had helped to keep them from the rocks for a long time, but that the wind and waves had been too strong for the vessel. Time and time again they all told how thankful they were that the lighthouse had been built on the lonely spot, and they all praised the keeper and his brave daughter.

One could tell hundreds of true stories like this one. All over the world the lighthouse quietly does

its best to keep sailors out of dangerous waters. If a boat is wrecked, the lighthouse keeper is always ready to risk his life to help in whatever way he can. Thousands of people can ride with greater safety upon the oceans and seas because of the work of the lighthouse and its keeper.

As you may suppose, it is no easy task to build a lighthouse. To begin with, it must be made strong. Lighthouses that have been carelessly made have been known to be crushed by the waves as if they were nothing but egg-shells! Still others have been broken off just as you might break a stick of macaroni.

In one gale that blew about the Mount Desert lighthouse in Maine, a boulder of stone weighing seventy-five tons was moved sixty feet. With such strong waves to fight, the lighthouse must be very, very strong if it is to stand. This is what makes it such a wonderful piece of work. It must be built in a place where building is difficult, and yet it must be strong so that it may be able to hold its own against the strength of the waves.

Years ago many of the lighthouses were made of wood, but this was found to be unsafe because of fire. Besides, the waves had the best of it when they had only to fight the strength of wood.

Men soon found that lighthouses made of stone were safer and more lasting. To-day some of them have stone walls seven or eight feet thick, with foundations that are sunk deep into the rock or sand. Most of the lighthouses are built like an oak tree, with a broad, flaring bottom and more slender upper part. Mother Nature plans wisely, and when she made the oak tree she made it the right shape to bear a heavy weight of leaves and branches. Lighthouses built in this way are strong like the oak tree.

Still others are made of iron, and are built in a queer shape, with legs like those of a spider. They have iron piles upon which the whole structure rests. These are the long legs of the spider. The light-keeper's home is the body of the spider, with a single bright eye of light at the top.

The waves and tides pass through the legs of the

spider lighthouse and do not destroy the building overhead. Many of these iron lighthouses have been built along the southern coast of the United States where there is no danger of moving cakes of ice filling up the spaces between the iron piles.

Lighthouses are hard to build not only because they must be made so strong, but because it is difficult to even lay a foundation for any kind of house in the places chosen for some of them. Often the foundation must be laid upon a rock that is covered with water. This rock may be in a part of the ocean where great strong waves come from all sides, so that the slightest wind makes a high sea. The Eddystone Lighthouse off the coast of England was built upon such a rock. It took years to build it because the rock upon which it was to rest was beaten by waves most of the time. To make the work harder, the stone and other material of which the house was to be built, had to be carried over miles of choppy sea. Then it had to be kept afloat in a boat until the sea waters were calm enough for the men to work upon the rock.

Minot's Lighthouse at the entrance to Boston Harbor was another hard one to build. It took three years before a single stone could be laid, and five years before the first light could be made to shine. This tower stands above the water twice as high as your house, but in storms the spray reaches to the very top and in winter covers the glass of the lantern with ice. When Mr. Longfellow, the poet, saw this lighthouse he said it looked like a huge cannon rising out of the sea. It does look like a great cannon, but it is stronger than the largest and strongest cannon ever made.

Over two thousand years ago men saw the need of lighthouses to help sea travellers, and one was built off the coast of Egypt, which stood for more than a thousand years. To be sure, this had no light such as one finds in the lighthouse of to-day. It burned fires of wood by night, and the smoke served as a guide to the sailors by day.

Since that long-ago time men have been building better lighthouses each year. Fish-oil was burned for a time in the lamps. Kerosene is now used.

The houses are bigger and stronger, and men have found better ways of building them in the most dangerous places where they are needed the most.

The United States has more than one thousand of these silent but useful helpers along her coast, and more than five million dollars a year is spent to keep them in good running order.

It costs money to maintain the lighthouse with its faithful keeper, but most countries are glad to help the sailors who must travel upon dangerous sea waters.

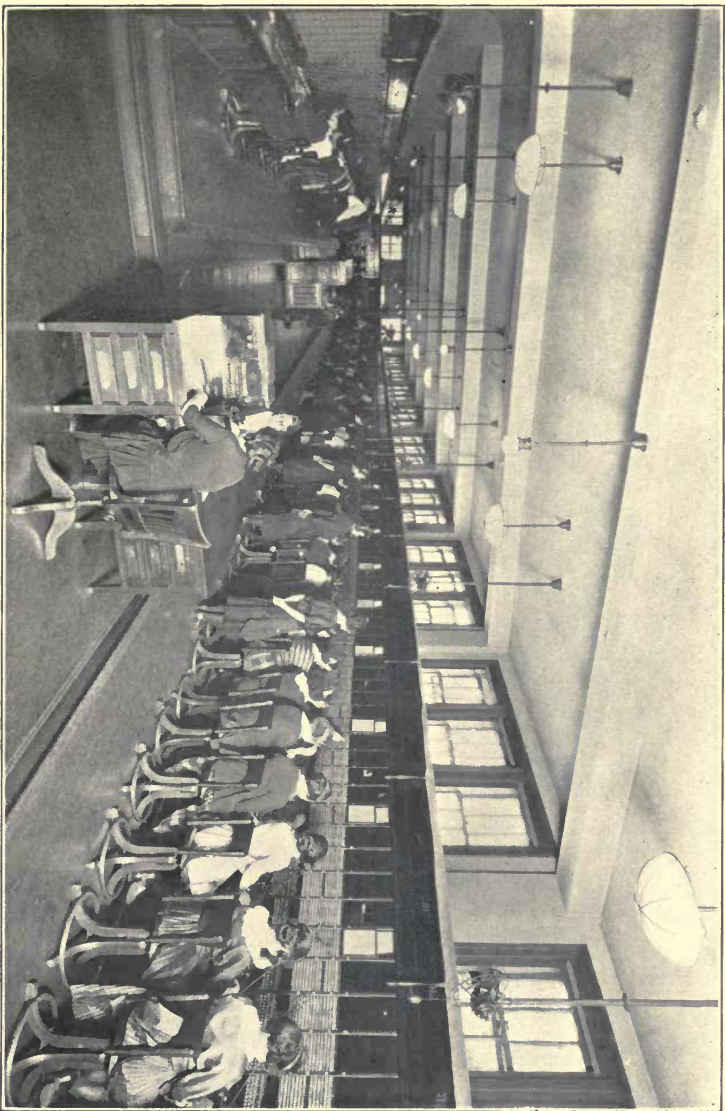
A SWIFT MESSENGER THAT CANNOT RUN AND DOES NOT RIDE

IF you could ask your great-grandfather how messages were sent when he was young, he might point to his feet and say: "My child, these were the messengers most often used. If one wished to send a message farther than he could walk, a man travelling on horseback or in a wagon or coach would take it for him."

"What about the telephone?" some child might ask.

Great-grandfather would smile at this. "When I was a boy there were no telephones," he would say. "If some one had told me that my great-grandson would be able to talk to some one living miles away, I should have thought him a dreamer."

Your great-grandfather would be right about all



A MODERN TELEPHONE EXCHANGE

this. When he was young, the man who invented the telephone was only a little boy himself. He could play hide and seek or fly a kite, but at that time he had not thought of making a telephone.

This boy, named Alexander Graham Bell, lived in Scotland. His father was an inventor who worked out a way to teach deaf and dumb children to hear by watching the movements of the lips of other people who were speaking. Alexander heard his father talk about this and other inventions and watched him at work. Alexander thought his father a very wonderful man. No doubt the boy learned a great deal from the busy, hard-working father.

All boys will grow, as you know, and Alexander was like the rest. The time came when he knew all the arithmetic, spelling, and writing that was taught in the eight grades of the grammar school.

He went to high school, and in a few years had learned geometry, physical geography, Latin, physics, and the other hard studies taught there. He went to the University of Edinburgh, but, even

when old enough to do this, the thought of making a telephone had not come to him.

Later he came to the United States and became a teacher in a school for the deaf and dumb in Boston. Here he kept trying to find out better ways to help deaf persons to hear. As time went on he worked out a better plan than his father and grandfather had used. He taught his pupils to watch the position of the lips and other organs used in speaking, and in this way they learned to know the sounds by sight. Then they learned to know when several sounds were being spoken together. After several lessons the pupil could tell all that a person was saying by looking at his moving lips.

Alexander Graham Bell knew a great deal, you see, about how people talk, and about how people hear with the human ear. It was what he knew about the ear that gave him his first idea for the wonderful invention of the telephone. He had not been teaching very long before he began to wish that he might be the first man to work out a good way in which to send spoken words that could be

heard over a wire. One pupil helped him more than any other by her kind words and her interest in his work. She was a young girl named Mabel Hubbard, who had been very sick with scarlet fever when a baby. Since that time she had been unable to hear or to speak until Mr. Bell had become her teacher. The father was grateful for what had been done for his daughter, and he, too, helped Mr. Bell in his work with the telephone. When Mabel Hubbard became the wife of her teacher she did more than she had ever done to help him to carry on the work of inventing a telephone.

Mr. Bell made his first telephone at odd hours after he had finished teaching for the day. He made it out of an old cigar box, several hundred feet of wire, and two magnets which he had taken from a toy fish pond. You see, at that time he was poor and had very little money to spend on materials.

One day when he had been working for many months, he told his assistant to listen at the end of the rude telephone which had been made to reach from the attic to the basement. Alexander Bell

went upstairs to the attic and telephoned to the man in the basement. "Come up here," he said. "I want you."

The assistant was surprised to hear the words, which were the first ever made to sound over any wire. Alexander Bell had at last made the first speaking telephone!

It was a great day for Mr. Bell, but he did not spend too much time in rejoicing. He knew that there was still a great deal of work to be done. First he wanted to get the invention ready to show at the great Exposition which was to be held in Philadelphia that year, which was the year 1876. People were to come to this from all parts of the country, and Mr. Bell knew that it would be a good place to show the telephone for the first time.

When the day came for the exhibits to be entered for the Exposition, Mr. Bell had the new telephone ready as he had hoped. The judges were busy all day, and he could not see them at all until late in the afternoon before the opening day. The judges were tired and wanted to go home. They

did not care to listen to the young man who stood before them timidly and said that he had found a way in which the human voice might be carried over wires by electricity.

A gentleman from Brazil happened to be standing in the doorway of the room in which the judges and the young man were talking together. Don Pedro was the man's name. He was the Emperor of Brazil, and a famous man.

Don Pedro saw how eager the judges seemed to be to go away without looking over Mr. Bell's invention. He was very angry. He stepped into the room and examined the new instrument. Then he turned to the judges and asked if he might not be allowed to try out the new telephone himself.

The judges had to be polite to the ruler of a country. "You may try it," they said to him. Mr. Bell went to one end of the wire which was in another room and spoke into the transmitter. Don Pedro heard plainly what the young man said, and praised him for his work in inventing an instrument that could carry the sound of the human

voice. "This is a wonderful invention!" he said to Mr. Bell.

The judges decided that they had made a mistake in neglecting to try out the instrument. They said that Mr. Bell might show his invention at the Exposition, although even then they thought it more of a toy than a work that could be of great use to the people.

Many looked at the new telephone in the days that followed. Strange to say, there were still many who could not see what a great piece of work it was. Like the judges, they called it a toy and thought little of it. Others were like Don Pedro. They said, "It is a wonder of wonders." Which of these people were right, no doubt you can tell.

By the time the year 1877 came, the telephone was being improved so that the public could use it. Still people did not know how much it could do for them, and it was not used a great deal. A long-distance line was built from Boston to Salem, which was sixteen miles. Mr. Bell himself thought that twenty miles was as far as the telephone could ever

be made to carry the sound of the human voice. This seemed far enough to him at that time. His first instrument could carry sound only from the basement to the second story of a single building. He must have been pleased later when long-distance lines were made to reach across the country. And how pleased he must have been when other countries of the world began to use his invention. Japan was the first, and others followed. To-day the telephone is used in far-away Abyssinia. The children of that country laugh at the monkeys which swing on the telephone cables. The elephants have their own use for the poles too. They seem to think that poles make good scratching posts. The children always laugh when they see these animals scratch their backs on the telephone poles.

In our country the people who once thought the telephone a toy now know that it can be made to do a great work.

Boys and girls of to-day know how true this is. Every day men, women, and children are able to save time and money because of this great invention

that is now well known to be a wonder of wonders.

When your mother wants to order groceries she does not have to go to the store, nor even wait for you to go. If she is in a hurry, she can telephone her order and the grocer will deliver the goods.

If your house were to catch fire, some one would telephone, and the clanging of the firemen's gongs would be heard coming up the street in a few minutes.

If the baby were to be taken sick in the night, the doctor could be at his bedside in less time than it would take for some one to walk to the doctor's office. A man living in New York can talk to another man living in San Francisco, which is three thousand miles away, without leaving his office chair!

We have become used to the comforts which the telephone brings, and we often forget that we are enjoying them. Now and then our telephone gets out of order. How we miss it! "The 'phone is out of order," we say in great dismay. "We must

have it repaired at once. We cannot get along without it!" We have to ask a neighbor to allow us to use his telephone, or it may be that we waste a good deal of time in going on errands when a few words carried along by electricity might have saved us all the trouble.

When the repair man comes to the door at last, mother lets him into the house in a very pleasant manner. We are all glad to know that we shall soon have the use of the telephone again.

Many people would rather do without their automobile than try to do without a telephone. It may be that most of the children who are reading this book would rather keep the automobile and let the telephone go if they had to make a choice. Ask your mother which she would rather do.

It is true that it was possible to send messages from one place to another before the invention of the telephone. By means of the telegraph messages could be sent, but they were written and not spoken. The telephone is greater than the telegraph because with it one can speak to another just

as if face to face. It is almost always better to be able to speak back and forth and hear the sound of another's voice.

Strange to say, another man had been trying to make a telephone while Mr. Bell was working on his model of one. Mr. Elisha Gray of Boston was the man. If Mr. Elisha Gray had finished his work just two hours sooner, he would have been the first man to invent a telephone that could be used. As it was, he was just two hours late in sending word to the government about his invention. Mr. Bell had let the government know about his work two hours earlier!

As you may know, when a man works out an invention, if he is wise, he will let the government know at once. The government keeps a record of the work and gives the inventor a patent, which forbids other men to manufacture the invention for a number of years unless the inventor wishes it.

If the government did not do this, a man might spend many years trying to work out something new. He might spend all of his money. When

the invention was finished, some other man might copy it and sell it without giving the inventor any of the money. This would be unfair, and most men could not afford to give up a great deal of time and money to work out an invention.

As it is, a patent on a useful invention often brings great wealth. Mr. Bell became a very wealthy man. Mr. Edison is also wealthy. Perhaps you could name others who have made money because of being able to make something new and useful.

Some children will want to know how the telephone does its work. It would take a great deal of time for you to read all about just how it is done. Your teacher or parents may be willing to tell you as much as you wish to know about it. When you throw a stone into a pond, ripples in circles may be seen going out in all directions. Your voice makes these tremblings or vibrations in the air whenever you speak. When you talk into a telephone these vibrations of air strike a small piece of metal that trembles too, and helps to send electric waves over

a wire. A metal piece on the telephone of the person to whom you wish to speak is made to tremble by the electricity, and the person who is listening gets your message. This is done almost faster than it takes to tell it, so swift is the telephone in doing the work.

The swift-running man or boy living in your great-grandfather's time could never carry a message with such speed. A man on horseback could not do the work so well. Our great express trains that rush across the country are not swift enough to carry messages hundreds of miles in a few seconds of time, as the telephone is able to do.

It is true that the telephone must have some help. When you ring your bell and hold the receiver to your ear, you will hear a voice which asks, "Number please?"

This is the voice of the girl who sits in an office before a telephone that can be made to connect with yours and many others. As soon as you take the receiver from the hook a little light shines over your number that is printed upon a board called a switch-

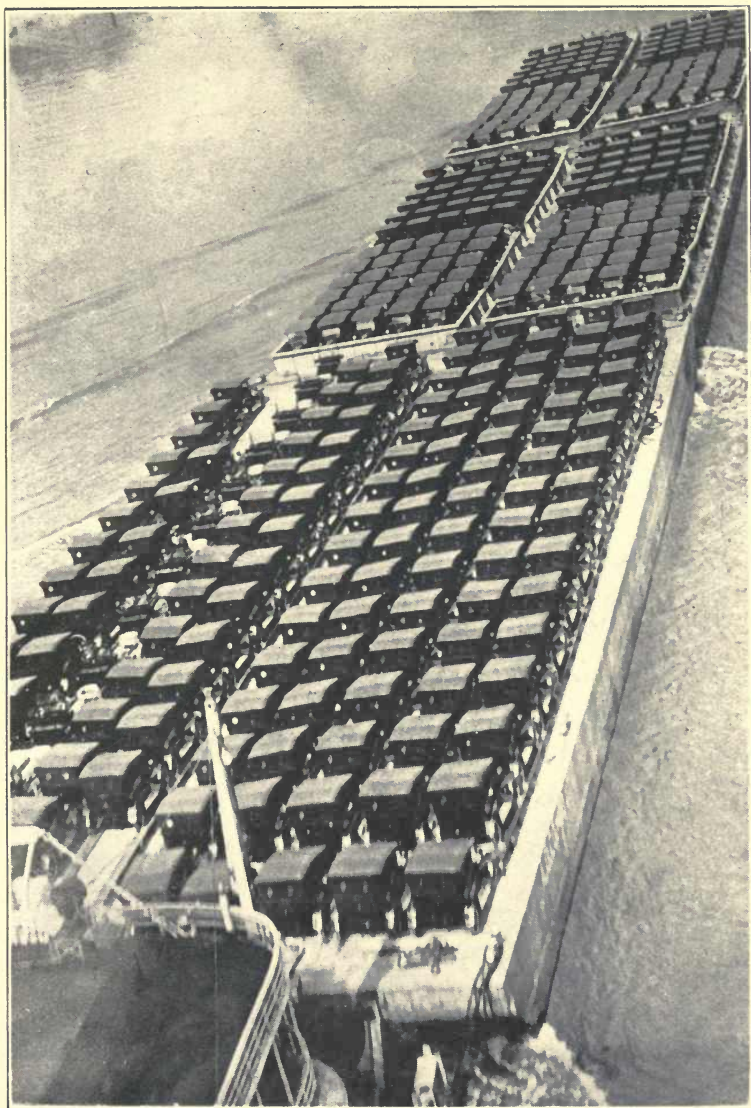
board in front of which the telephone girl sits. When she sees the light she knows that some one using your telephone wishes to send a message. When you have given her the number you want, she connects that wire with your telephone and rings a little bell. When the person who answers the bell takes the receiver from the hook, another light appears on the switchboard. When the receivers are hung up again, the little lights go out and the telephone girl knows that you have finished talking. She then disconnects the two lines.

Some children know how to make a kind of telephone. They fasten a string tightly to the bottoms of two cans. One end of each can they leave open. The open end of a can is held to one child's ear, while the second child talks into the open end of the other can. The one who is listening can hear what is being said if only a short distance away.

This kind of telephone would not work well for long distances. Your mother would have to send you for the groceries, and your house might be burned to the ground before the firemen could get

the alarm, if this were the only way in which messages could be sent.

The telephone that has electricity for a helper is a swifter messenger and a better one.



ONE OF THE LARGEST SHIPMENTS OF FORD CARS ON RECORD

A CAR THAT SEEMS TO MOVE OF ITSELF

THERE once lived a farmer boy near the city of Detroit, Michigan. Every morning this boy walked two and a half miles to school, and every afternoon there were the two and a half miles to walk before he reached his country home.

This boy was named Henry Ford—a strong boy, and one who was willing to work, as you shall see. Even when he had studied all day at school and had walked the five miles Henry Ford was ready for more work. He helped his father about the farm or busied himself about the workshop which he had made for himself. Here he had a few crude tools which he had also made. There was a vise, a bow-string-driven lathe, and a rudely built forge. The first tool Henry Ford ever made was not in the workshop, but he never forgot it, because he had made it with great care. When he was a very small

boy he made his first tool out of one of his grandmother's knitting needles. He heated the needle until it was red hot. Then he plunged it into a bar of soap as he bent it into shape. When he had whittled a wooden handle to which the needle was fastened, the tool was done.

Henry Ford liked to make tools, and he made some that many a boy would have been proud to own. What he liked best of all was to take pieces of machinery apart so that he might have the fun of putting them together again. In this way he learned about machinery, and the more he learned the more interested he became. He soon came to have one great wish. He wanted to learn how to make something that would go.

Before Henry Ford was seventeen years of age he left his father's farm and went to work in a mechanic's shop in Detroit, Michigan. Here he learned more about mechanics, and he spent many of his spare hours in the workshop which he again fitted up for himself. By the time he was twenty-one years of age he had built a farm locomotive

mounted on iron wheels taken from a mowing machine. To be sure, this locomotive seemed to be of no use except to frighten the cows. When Henry Ford ran it up and down the fields the cows ran from it in all directions. He thought it great fun to see them run, but he was not so well pleased when the people of the town made sport of him and his horseless wagon, as it was called.

Henry Ford was the kind of man who works harder when difficulties appear. He wanted to make a better wagon run by a motor, and he worked very hard to bring this about. In the workshop fitted up in the barn behind his home he spent many hours working and planning. He had to use junk for his wagons because he had no money with which to buy better material, but he soon had a wagon driven by gas that would go along the road. He called it "Ford's buggy driven by gas." He liked it fairly well, but the people made fun of it.

Henry Ford let the people laugh as much as they wished, but he did not give up making cars. He kept on making better ones until at last he suc-

ceeded in making a car that would run on level ground, would run up and down hill, and go backward and forward. He was well pleased then, and his new car was watched eagerly by the people of his city.

No one made sport of this new car. Every one thought it very wonderful indeed, which it truly was.

“See! The buggy moves itself!” the children cried when they saw one come up the street.

“Who would have thought that a buggy could be made to move along without horses?” the men shouted. People everywhere were filled with interest.

Those were happy days for Henry Ford. He kept on making cars, and while he made them he tried to learn new ways to make them better and cheaper.

At last he formed the Ford Motor Company, which turns out more than fifteen hundred new cars every day, and sells each one for less money than any car of its kind in the whole world.

Henry Ford did not make the first automobile in the world. While he was trying to make a motor car that could be run by gasolene, other men were working along the same line. Men like Mr. Haynes, Mr. Olds, and Mr. Duryea were making automobiles that would run by gasolene engines, but Mr. Ford's new car soon proved itself to be the best one of its kind at that time. In a very short while it was being used in the greatest numbers.

To-day there are hundreds of cars of different kinds and makes. There is the Buick, the Cadillac, the Dodge, the Chevrolet, the Peerless, the Pierce Arrow. Most boys and girls can name a dozen different kinds of cars without much trouble. The automobiles that are made to-day are all better looking than Henry Ford's first cars. The first ones were made short and high. To-day they are much longer and lower and more graceful looking. They are made to give greater comfort, and can run faster and better. Henry Ford's first automobile went very slowly. Now an automobile can go very, very fast if the driver wishes. A racing car can go

more than one hundred and twenty miles an hour, which is even faster than an express railroad train! Think of two places a mile apart. Then imagine riding from one place to the other and back again in a minute's time. Henry Ford's first car would surely take the booby prize in such a race now, although when it was first made it was the fastest car of all. This shows how much better the automobiles are being made as time goes on.

To one who is not in the car, the automobile seems to be moving of itself, but most people know that this is not true at all. Inside the hood which reaches out to the front of the car is a powerful engine that is run by the explosion of gasoline.

Just how the automobile is run by the explosion of gasoline is easily understood. Most boys have shot off a gun, and they know what happens when the trigger is made to strike the cartridge. The powder in the cartridge explodes and the bullet is forced out through the barrel of the gun because this is the only way in which it can escape.

A CAR THAT MOVES OF ITSELF 77

In the automobile the gasolene flows from the tank through the carburetor into some hot pipes, where a part of it turns into vapor. From the hot pipes the vapor goes into the cylinders where a little spark of electricity causes it to explode. The pistons which are in the cylinders are forced down when the explosion takes place, just as the bullet in a gun is forced to move when the powder explodes. The pistons are fastened to the crank-shafts that run back to the axles of the rear wheels of the automobile. When the pistons go down, the crank-shafts are made to turn the back wheels and the car moves along.

The automobile will run along alone after it has been started, but there must be some one to steer it and to make it stop. The man who steers the car sits upon the front seat with his hands upon the big steering wheel. He can make the car go slowly or fast, as he wishes, and he can stop whenever he desires. Now and then he must stop to buy gasolene, which the engine uses for fuel. There is enough gasolene used by automobiles every year to

make a belt of five-gallon cans reaching around the equator not only once but twice! This shows how much the automobile has come to be used, and it is no wonder!

When the grocer or other merchant wants to deliver his goods quickly, his automobile helps him to make the deliveries with little trouble.

When the doctor makes his calls he can help many more patients in a day by using his automobile.

And when the pleasant summer days come, the boys and girls whose parents or friends own an automobile can enjoy many a beautiful day in the country.

Most boys and girls have taken trips of this kind. Children who live about the state of New York like to drive out to West Point to see the boys who are learning to become soldiers. The boys march around in drills of many kinds, or ride about on the backs of horses.

Along the Hudson River there are many pretty spots that make good picnic places, and the Catskill

and Adirondack Mountains are always favorite places for automobile travellers.

Children who live near the state of New Jersey are often taken to Atlantic City in automobiles. There one can stop to bathe in the ocean or play in the sand. There are many other amusements in Atlantic City too. There are ponies to ride, roller coasters, shoot-the-chutes, and big merry-go-rounds. The merry-go-rounds have prancing horses, wild-looking zebras, long-necked giraffes, and other make-believe animals for children to ride, while gay music makes all the riders feel just as gay.

There is a board walk which follows the ocean for a number of miles, and along it are shopkeepers who sell toys of all kinds as well as ice-cream, candy, and lemonade.

If one cares to hear music, there are bands and orchestras which play upon the piers or in the hotels, and there are moving pictures for those who might care to see a favorite actor.

Children who live around Chicago enjoy driving to the sand dunes upon the southern shores of Lake

Michigan. With so much sand children can build great tall towers, hills, or mountains. The deep caves some children build make one think of what happened to Aladdin who found a wonderful lamp down in a deep, roomy cave.

Out in California there are the giant trees for children to see. Automobiles can drive right through the trunks of some of these.

At Yosemite Park there are many kinds of flowers and strangely beautiful mountains. Children who have never before seen much of California like to drive by the orange groves and along roads that are shaded by the spreading palms which are only found in warm sunny climates.

Washington, D. C., has much of interest for boys and girls. Many well-known persons live in Washington. It is here that the President lives in the White House. The Capitol building, where the laws of the country are made, is often visited by automobile travellers too.

It may be that a few of the children who read this book have driven across the whole country in an

automobile. The children who have taken a trip of this kind can tell many things about their country that children who study geography only out of books can never know. When you read about a mountain or see a picture of one, you know a little about how it looks. When you slowly climb a mountain in an automobile, and perhaps eat your lunch among the shrubs and plants that grow upon its slope, you have seen a real picture of a mountain and know more about it.

Some automobile tourists travel in their cars as far as one of the ports of the Great Lakes, like Buffalo. Then they drive their automobile on to one of the lake steamers, which carries them far away over the waters. The automobile has its turn to ride then, and the children who have been riding in it have a different kind of ride. When they reach the end of the lake trip, the automobile is driven from the steamer and the travellers drive along on land again.

Almost every child can tell more ways in which the automobile has proven of use. The farmer

sometimes uses the tractor, which is a sort of automobile that can plow the ground very quickly and very well. A man who has hundreds of acres to plow in the springtime is glad to have a tractor to help him do the work.

Many children have never seen a tractor at work plowing up a field, but almost every child knows what use can be made of an automobile on moving day. When that time comes, the mover brings one of his great moving vans and almost all of the furniture can be hauled away at one time. People everywhere save a great deal of time on moving day because of what the automobile can do for them.

Even in war time the automobile was sent on errands here, there, and everywhere. The armor cars, ambulances, transport trucks—you have heard all about these.

Do you wonder that automobiles are being bought in greater numbers each year? When the year 1923 closed there were almost *eleven million* (11,000,000) passenger cars in use in the United

A CAR THAT MOVES OF ITSELF 83

States, and more than *one million* (1,000,000) motor trucks and business cars!

The car that seems to move of itself has proven of use in more ways than one can tell, and this is why so many people wish to own one. In war time, in days of peace, in the city, in the country—is it not true that the automobile can be of use anywhere?

PICTURES THAT SEEM TO BE ALIVE

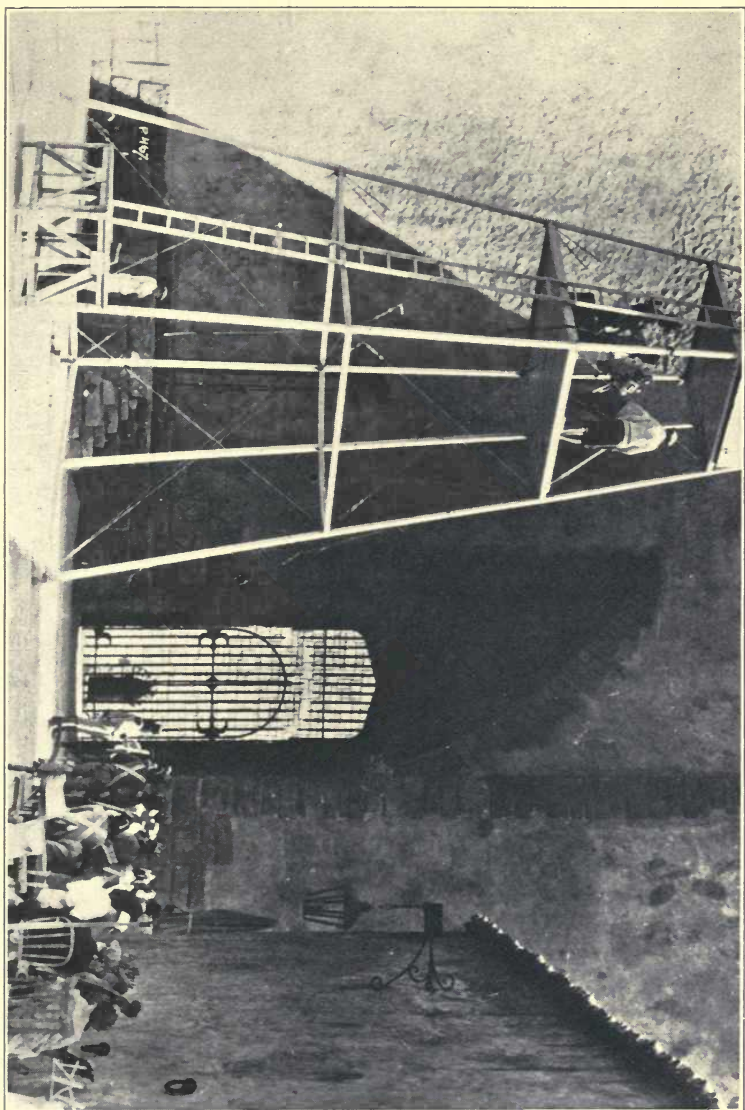
WARREN and Jack sat in the dark moving-picture theatre one day. Warren was a very small boy, and it was his first visit to the theatre. Jack was older, and knew all about the pictures. Warren sat with his mouth open. He had never seen such strange sights as were shown upon the screen that day.

Suddenly a big black bear came out in the picture. He showed his teeth and started to run. It looked as if he were running toward the children in the theatre.

Warren climbed down from his seat and hid behind the back of the one in front of him. "The bear is coming!" he cried.

Jack laughed. "Do not be afraid. It is not a real bear," he said.

Warren did not seem to hear. He sat upon the



CAMERAMEN TAKING A PICTURE FROM AN ELEVATION IN ORDER TO GET AN UNUSUAL EFFECT

floor and pulled at Jack's legs. "Take me home!" he begged.

The bear turned around and started to run away. "Look! Look!" Jack cried as he pulled Warren up on to his feet. "The bear is running away!"

Warren looked timidly. Sure enough! The bear was running away as fast as he could go.

Warren climbed back on to the seat, and watched the pictures very closely for awhile. He kept thinking that the bear would come back. At last he forgot all about the bad-looking bear when the funny man appeared. All the children laughed and shouted when the funny man fell into a barrel of water.

A few years ago children could not see pictures that look so real they seem to be alive. The only bears that could frighten the smallest children were at the zoo. Some children never saw any bears at all except in picture books. The only funny stories children knew were the ones they read or a few that were told to them.

To-day children may see a funny picture almost

any time they wish, and pictures of animals are shown time and time again. Some animals are only known to children because of the moving picture.

The kaola had his picture taken one day. He looks like a teddy bear, and is very cunning in his ways. When his master takes him in his arms the kaola cuddles up close and seems to enjoy being petted. When dinner time comes, he will eat nothing but eucalyptus leaves. The man who buys his food had to send to California for a load of eucalyptus leaves for little kaola as soon as he arrived from Australia.

Very few children have seen a lizard eat his dinner, but many children have seen the moving pictures that show this strange creature at meal time. He eats whole eggs without even stopping to chew them. Shell and all, the lizard devours the eggs and seems to think them very delicious.

Old Mr. Turtle had his picture taken one day too. He had had three hundred birthdays, so one would expect him to be rather slow, but, strange to say,

he was always like this. Even in his younger days he moved along as if he had plenty of time for what he had to do. If a hare should have a race with him, the hare could take a very, very long nap and still have a chance to win the race.

Then there are the penguins who live in the far north country, the otters that are like seals, and many other animals.

In some of the comedy pictures animals are the only actors. There is a town policeman. A monkey dressed like a policeman may take this part. A railroad train runs through the animal town. There is a dog for a brakeman on the train, and a conductor who must bark when he asks for the passengers' fares, because he too is none other than Mr. Dog Conductor. Cats dressed like children play in the streets, and ducks and geese dressed like women of the town go marketing with their baskets upon their arms.

Insects and birds often do their work, or play upon the screen for children to see. The caterpillar spins its cocoon cradle and goes to sleep.

When it has slept a long time it comes out of the cocoon, but it is no longer a caterpillar. It has changed into a butterfly with gay-colored wings of great beauty. It is as if it had been sleeping in a fairy cradle. Some children have never seen a real butterfly come out of a cocoon, but many children have seen screen pictures of caterpillars.

When bees buzz around in the fields most children run away if they come near. Few children would care to look about the inside of a beehive while the bees were there, but pictures of bees and their homes are safe to see. The bee nurses, who take care of the baby bees, have little brushes upon their legs. The bees who collect the pollen from the flowers have pockets in which to carry it. The nectar which they get from the flowers is carried in pockets too. In the moving pictures a bee can be made larger than he really is, so that one gets a very good idea of how he looks without getting into any danger.

Baby birds are hard to find. Parent birds build their nests in places well hidden by leaves of trees

or shrubbery. The oriole's nest hangs from a branch like a cradle, and is built so near the end of the branch that a boy or girl could never reach it. In the moving picture one can see the oriole babies and their parents as well. One never cares to disturb Mr. or Mrs. Oriole when they have seen a picture of their cunning little ones and know how hard the parents work to get enough food to satisfy them.

The strange peoples of the earth could never become known to children through reading alone. One can get a much better idea of people who may be seen moving about at work or play. Most children like the pictures of the Eskimo babies eating their blubber or drinking oil. The Eskimos' games in the snow and their swift rides in dog sledges are a pleasure to see.

Then there are the countries of Europe and Asia, and the far-away land of Africa! When you have seen the Chinese children sitting upon the floor in their strange schools you are glad that your schools are made with comfortable seats and desks. When

you see what happens when earthquakes bring disaster to countries like Japan, you are glad if your home is in a country that is seldom visited by these great disturbances. When the pictures show some of the wild and fierce animals of Africa howling about near the rude huts of the African children, you are glad if dangerous animals are not often found near your home.

At other times the pictures of foreign countries show scenes that make one long to be able to visit the place or even live there.

There are the scenes which show children playing about in gardens filled with blossoms of wonderful beauty in the Japanese country. Italian children are shown riding in gayly-decorated boats upon the waters of Venice or other cities of Italy. Dutch children may be seen skating along some of the frozen streams of their country. These waterways are many miles in length, and the Dutch children can skate for a long time without having to turn around.

When the great World War was being fought,

there were pictures of the trenches filled with men getting ready to engage in battle. Soldiers marched here and there, and aëroplanes did their part in watching the movements of the enemy or hurling bombs when it seemed best to do so. Oh how carefully fathers and mothers looked at the pictures that showed what was going on at the front in those days!

When peace was made, the moving picture helped to show the people, who could not see the real parades, what was being done to celebrate the making of peace.

Moving pictures often have news stories to tell. When the Russians were starving for lack of food, people in other parts of the world were more willing to help when they had seen pictures that told how much suffering there was in the country of Russia. And when the President of the United States takes a trip or makes an important speech, there is almost sure to be a camera man taking moving pictures of his actions.

Perhaps, most of all, boys and girls like to see

other children play stories for them. Almost every child has laughed at some actor like Jackie Coogan or Baby Peggy. They may have cried a little when the pictures showed that these actors were in trouble. Jackie Coogan has thousands of letters from boys and girls all over the country, and Baby Peggy could never read all of the letters that have been sent to her. Children feel that they really know the boys and girls who act for them, because the pictures make them seem so real.

Some children like the grown-up actors almost as well as the younger ones. They like to watch Charley Chaplin, who is the funniest man some of them have ever seen. An old derby hat, grandfather's cane, a pair of baggy pants, and a big old pair of shoes has made many a boy into a make-believe Charley Chaplin at home when the real show was over. Some of these make-believe Charley Chaplins can play tricks that are almost as funny as the ones they have seen in the pictures.

Sometimes giant men become actors in the movies. One giant man is over eight feet tall. He

makes the children laugh when they see him riding in his Ford automobile. He has had to have a hole made through the top of it. He looks very funny riding along with his head and shoulders extending through the top of the car. One dwarf man of the movies is only three feet tall. This is as tall as your school yardstick would be if it were placed on end. When the giant man is in a picture with the dwarf man the two can be very funny.

Moving pictures often tell a story that has been printed in a book before. "The Thief of Bagdad!" Did you ever read this Arabian Nights story? If you have never read it, you must get the Arabian Nights tales from the library, or read the story from your own book, if you own a copy. Then when you have a chance to see the moving picture of the story, try to do so if you can. You will see a magic carpet that sails through the air far above the heads of the people, faster than the fastest aeroplane in the world. You will see a city that hangs from the clouds, a winged horse, and many other wonders. If you like adventure, you

will watch the hero carefully because he has much to do before he gets possession of the hidden treasure which makes him rich enough to woo the princess.

Mr. Douglas Fairbanks is the hero of the picture. He took charge of the making of it too. He sent to all parts of the world for men to help him make the story seem real. There were dancers from Java, China, and Japan, as well as other parts of the East, slaves from Africa, magicians from Persia, and artists from many other countries. It took a year and two months to make the picture, but it is worth the time and work that were put into it.

When you have seen this picture you will never forget the story of "The Thief of Bagdad." No doubt you could name many other stories that you will always remember because you have seen them upon the screen in the moving-picture theatre. "Little Lord Fauntleroy," "Pollyanna," "Rebecca of Sunnybrook Farm,"—perhaps you have seen many or all of these.

Moving pictures are a pleasure to see, and

they may teach us a great deal. Every one seems to know that. But how are they made? Some people have not thought much about this. The first device which could be used to make a picture that moved at all was nothing but a sort of toy and was called a zoetrope. It was a rolling cylinder having many slits in the outside. By looking into the cylinder through one of these slits one could see a picture. The pictures were placed within the cylinder in such order that the objects seemed to be moving when the cylinder was rolled fast enough.

Other devices like the zoetrope were made, but none were like the modern moving-picture machine.

It was not until a little more than thirty years ago that the first moving-picture machine was shown to the people. This first machine was called the kinetoscope, and was made by Mr. Edison. It was shown at the World's Fair in Chicago in the year 1893. The machine could not do the splendid work that the cinematograph of to-day can do, but it aroused a great deal of interest. After it had been shown, Mr. Edison and other men kept on trying

to make a better one, until we have now the machine that does the good work we see everywhere.

All over the world men travel to take pictures so that we may know how the most distant countries and peoples look. Sometimes the picture must be taken from a place high up on a mountain. Other pictures have been taken away down at the bottom of the ocean. Indoors, outdoors, from aëroplanes, ships, or tall buildings,—everywhere men go to get their pictures. Many are at work to make the pictures of interest too. The author writes the story, the actors make believe they are the people who are a part of the story, the director tells the actors what to do, the camera man takes the picture. Besides this, there are the electricians, the men to take care of the lighting of the stage, the men who arrange the scenery, and others.

With so many helpers at work, it is no wonder that the moving pictures can be made to seem alive and real to us.



WESTINGHOUSE STATION KDKA, EAST PITTSBURGH, PENNSYLVANIA
"The Pioneer Broadcasting Station of the World"

A SERVANT THAT WORKS WITHOUT PAY

NEARLY every boy knows about radio. Some boys know as much as their fathers and mothers. They know how to fasten one end of a wire to a tree in the back yard or to the roof of the house. The other end is fastened to a box inside the house. When all the parts have been put into place, music or stories can be heard. Some of the boys have to put a sort of telephone receiver to each ear in order to hear the music or story. To others it comes from a big horn and can be heard all over the room.

Most children know that it is radio waves which carry the music and stories through the air. These waves travel in all directions, through trees, animals, and even through the walls of houses. They travel swiftly too,—around the world more than seven times in one second they can travel.

The boy who makes a radio set knows how to

catch the waves and bring them into the house so that he can hear what they may have to say. Radio is like a willing servant. All that one needs is a set of coils and wires that have been put into their right places. Then radio will come into the house and bring whatever music or stories some distant person wishes it to bring.

Most servants work for but one family at a time. It is not so with radio. Thousands of people are served by this willing worker at the very same moment.

You have seen what happens when a stone is dropped into a quiet pool of water. Little ripples or waves spread out in all directions. The waves in the air, called radio, are set into motion in much the same way, but it is electricity that makes the splash in the air just as a stone makes the splash in the water.

All about us everywhere the sounds of voices are being carried through the air by radio waves, but we can hear them only when the electricity in our radio sets has helped to make the sounds stronger.

And what pleasant times children have when they listen to what radio brings them!

Most children have read some of the animal stories that Mr. Thornton Burgess has written. With the help of radio Mr. Burgess sometimes tells stories about the animals to thousands of children in the country at one time. Children are always glad to know what happened to Peter Rabbit, to Chatterer the Squirrel, or to Paddy the Beaver.

With the help of radio, the man who wrote the story about Dr. Doolittle has told thousands of children about the funny things that happened to the strange doctor and his friends.

Children who live around the city of New York can very easily hear the Man in the Moon tell his bedtime stories. Uncle Wiggly stories are often carried by radio from Philadelphia to homes all over the country.

It is not only children who enjoy what radio brings. Grandmothers, mothers, fathers, aunts, and uncles find that radio has something for them. Perhaps grandpa likes the funny stories the best,

while grandmother may like the old, old tunes. The older girls and boys sometimes like to dance to the music that some good orchestra plays for them. Father is always glad when radio brings him the latest news of the day or the reports from the markets, while mother may like a talk on how to make a new kind of dressing for the chicken she is to roast for the Sunday dinner, and she always likes to hear the music. When the President of the United States makes a speech, every one wants to listen!

Out upon the sea radio is as faithful a worker as upon the land. A few years ago a great boat called the *Titanic* struck a large iceberg in the deep waters of the Atlantic Ocean. In a short time the boat had sunk, and the people who were alive at all were swimming about in the icy waters or were huddled together in open rowboats without shelter. Before the *Titanic* went down, the S. O. S. message had been sent out by radio, and within a short time a big friendly steamer had made her way to the scene of the disaster. Hundreds of lives were

saved that day, and people praised radio for the wonderful work that it did.

One time a ship carrying the well-known Mr. William Jennings Bryan was grounded upon the beach of one of the Bahama Islands. This ship was named *Prinz Joachim*. The radio operator of the ship sent out a call for help which was first heard by the owners of the vessel, who had their office in a skyscraper in the city of New York. They at once sent messages to all the land stations along the Atlantic coast. From these stations messages were sent out upon the waters for near-by steamers. Within a short time a vessel happened to be passing near the Bahama Islands and received the message telling of the trouble that had befallen the *Prinz Joachim*. This ship hurried to the scene as fast as it could.

In the meantime the people on the grounded vessel would have been very anxious and worried had it not been for their hope in radio. They all thought that it would bring them aid, which is just what it did. A few hours after the first mes-

sage had been sent, the passengers were taken from the *Prinz Joachim* by a rescue vessel and were on their way again.

One could easily fill a book with true stories of how radio has saved lives at sea. Cases have been known where men have been taken sick on board ship with no doctor present to give advice. Then radio has sent out the message HDKA, which means "Help Wanted For Just One Person." When this message is heard every one tries to get help to the person in trouble as soon as possible. The life of a captain of a steamer off Florida Keys was saved because of the quick help brought by radio. The captain became very ill with poisoning. With the help of radio a doctor on shore told the captain's friends what to give him to keep him alive until the vessel could reach the nearest port. At the port an ambulance was sent to the boat to take the captain to a hospital.

When the great cities of Tokio and Yokohama in Japan were destroyed by earthquake, it was the messages carried by radio that let the world know

of the trouble so that food and clothing could be sent at once.

On a cold winter's night in the year 1924, the navy balloon called the *Shenandoah* was moored to a mast at Lakehurst, New Jersey. A gale came up from the southeast. Rain and sleet were blown by a strong wind that made the wires which held the balloon to the mast strain and pull back and forth.

Suddenly the wind drove against the *Shenandoah* with such great force that it tore the balloon from its mooring and sent it adrift into the stormy heavens.

Some of the ship's crew quickly let fall overboard four thousand pounds of water, a great heavy box of food, and some gasoline tanks. This was to lighten the weight of the ship and keep it from plunging to the ground. While all this was being done, a part of the crew set the engines to working. This and many other things had to be done quickly in order to keep the *Shenandoah* from being destroyed within a very short time. No doubt you may have read about it. People everywhere

praised the captain and his men for their good work.

It is true that the crew of the *Shenandoah* worked wisely and well, but radio had a share in helping to send the great balloon back to its proper landing place in safety.

When the captain and his men were lost in the darkness, telegraph messages were sent out by them, and radio carried back to these men messages of comfort and cheer from the stations along the way. With the help of radio men told the captain just where his ship was, so that he might steer as carefully as the storm would allow.

On that stormy winter night radio told thousands of people all over the country just where the great balloon *Shenandoah* was being seen from time to time. When the word was sent through the air that the ship was headed toward its own landing place in New Jersey people praised radio. "How useful it is," every one thought. "Who can tell what wonderful things it may be able to do in the future?" many said.

Explorers and men who travel in the far northern countries are full of praise for radio too. There was a time when these men were lost to the world when they journeyed into these distant regions. This is not true any more. Mr. Macmillan, the great explorer, could hear the news of the day and listen to songs or stories by radio during the long evenings when he was icebound in the North. He forgot that he was miles away from his home when radio helped him to hear what was going on in one of the city theatres or churches.

Captain Amundsen, the discoverer of the South Pole, will carry a radio set with him on all of his future trips to the far-away lands in that region.

Many a farmer spends an evening listening to a program of music from a distant city, or he may learn how much he should get for his corn or hogs. Sometimes he lets radio tell him what weather to expect for the next day, as there are many kinds of work about a farm that are done best in fair weather. Produce of many kinds is best when shipped on pleasant days. Haying in rainy

weather would be unpleasant as well as unwise. The orchard heaters must be used on nights when a frost is due. Spraying of trees and bushes is best done when there is no rain to wash away the poison.

Radio has not always been the well-known wonder worker that it is to-day, and there are some tribes in South America and Africa who are so uncivilized that they know nothing about it even now. When a message must be sent to a distant people they cannot even write a letter or telephone. They set a large hollow log on end in the water. Upon this log they pound with a heavy club. The pounding makes vibrations, which in turn make ripples of waves in the water. These ripples are carried up and down for a distance of several miles. The one who receives the message holds his ear to one end of another log set up on end in the water.

Long ago the Indians used smoke when they wished to send a message from one place to another. They placed a blanket over a smoldering fire, and an Indian would raise it from time to time to let out some of the smoke. These smoke signals

carried messages to other Indians who might be several miles away.

The Indians had a way of beating upon the ground in a certain manner too. The beatings would make vibrations that could be heard by trained ears for long distances. The Indian who wished to receive a message of this kind would lie perfectly quiet with one ear to the ground. Since each tribe had its own sign language its secrets could not be understood by the enemy in times of war.

The people who lived in Greece and Rome filled pots with straw and oil. They arranged these in a certain order upon high places. Then they lighted them.

A number of years ago the country of France was engaged in a war known as the French Revolution. Semaphores were used for signalling at this time, and for a number of years afterward. Engineers are even now given signals by this means in all parts of our own country. When the French used the semaphores for signalling, they were able

to send messages for long distances because of their telescopes with which they were better able to see distant signals.

Then after a few years Mr. Samuel Morse helped to bring the electric telegraph into use. In 1844 the first message was sent from Baltimore to Washington. "What Hath God Wrought!" was sent by means of dots and dashes, which stood for letters.

Later Mr. Morse got his friend, Mr. Field, interested in making a cable so that messages might be sent across the ocean from one country to another. This was a hard piece of work. Mr. Field had to try many times before he succeeded in connecting the countries of Europe and America in this way. The first cable which he tried to lay did not hold well at all. After a few miles had been laid, the cable parted and the men had to sail back to port and plan the work over again. A second trial was made, and the cable parted again. It is needless to say that the loss amounted to more than a million dollars and many people were discour-

aged. Mr. Field went on with the work and did not stop until twenty-five hundred miles of cable lay upon the bottom of the Atlantic Ocean. For a number of years cables have extended from our shores to all parts of the world, and our people have been able to send messages to the people of other countries separated by thousands of miles of water.

After the cable was put into use, people wanted to speak to one another at a distance, just as they would speak if they were in the same room. When Mr. Bell had invented the telephone, this, too, was made possible.

Then came the idea of sending a message to another without the use of wires, and Mr. Marconi brought into use what is known as wireless telegraphy. In this system an instrument records dots and dashes which stand for letters.

This was a wonderful piece of work, but men did not stop even there. They wanted to be able to *speak* to another at a distance without the use of wires!

Many men worked upon this. One man found

that radio waves are travelling through the air all about us. Another man learned how to catch some of these waves and send them forth again. Mr. Hertz was his name. Still other men worked out ways in which to make the waves carry the sound of music or the words of a speaker. Then a way had to be made to make these sounds louder so that they could be plainly heard.

All this did not come quickly. It was not until the year 1915 that the first words were carried from Washington to Paris without the use of wires, and it was not until six years later that people everywhere began to use radio. It was at this time, in the year 1921, that programs were first sent out into the air—from the city of Pittsburgh. There was good music, and there were talks that people liked. People began to be greatly interested, and radio sets were bought in large numbers. To-day thousands of these receivers are ready to catch the pleasant sounds that come through the air every day from all over the country.

Although we are all enjoying much that is being

brought to us through the use of radio, our grandchildren will no doubt put this great invention to even greater use than we of to-day. It may be that at some distant time certain ships will be run by men who are miles away. This was tried with one of the navy boats some years ago and found to work very well.

In future wars it may be that torpedoes will be made to travel through space without stopping until they have hit their mark when radio is made to direct their path.

A photograph of President Harding was sent across the Atlantic Ocean a few years ago. The work of sending photographs will be perfected as time goes on.

Almost every servant can improve upon his work, and this is true of radio. Perhaps in a short time we shall have trained it to do its work so well that even the far-away peoples of Japan and China will be able to talk and sing to us!

A MACHINE THAT TALKS AND SINGS

ALMOST every child who reads this book has had his picture taken at some time. Many children have cameras or kodaks and take pictures of their own. Most children like to take pictures of their friends or even of their animal pets. It is great fun to do this. A rabbit takes a good picture, and a dog can be made to look as if he were alive.

There is one kind of picture that children never take. This is the picture of their friends' or of their pets' voices. It may be that some children have thought this could not be done.

Many years ago a clever man named Mr. Scott worked out a plan for taking this strange kind of picture. To begin with, Mr. Scott knew a great deal about what happens when any one speaks. He knew that every one has in his throat a mem-

brane that quivers whenever he talks. These quivers set the air in motion. It is these waves of sound which travel through the air and strike the drum of the ear. This is the way in which we hear.

Other men had known this, but no one had ever worked out a way to take a picture of the sounds until Mr. Scott made his phonautograph. The phonautograph was a curious machine made upon a frame shaped like a barrel. Over the end of the barrel a thin membrane was stretched tightly, and in the center of this membrane a stiff hog's bristle was fastened. When some one spoke with his lips close to the outer end of the barrel, the membrane across the other end would quiver. This in turn moved the stiff hog's bristle. The bristle would move back and forth, leaving a wavy line upon a cylinder that had been covered with lamp black. The black wavy line was a picture of the voice that had been spoken into the barrel.

If Mr. Scott had been able to go on with his invention, the phonautograph might have taken the place of the phonograph, and Mr. Scott might have

been a more famous man than he turned out to be.

But Mr. Scott could not think of a way in which to make the picture of a voice talk or sing. It took another clever man to work this out. Mr. Edison was the one to do this work twenty years after Mr. Scott had taken the first pictures of a man's voice.

Mr. Edison, as you know, was the kind of man who worked upon a problem all day and all night if he thought that this would help to solve it. He was used to hard problems because he had been a poor boy who had to work very hard. His father was a laboring man, and Thomas Edison had to earn money when other boys of his age were still in school.

Most boys are in the sixth or seventh grade at the age of twelve years. When Thomas Edison was twelve years of age he had had what little schooling he was to receive, for he had attended school but two months in his whole life. His mother taught him at home, and at the age of twelve years he had learned all that she was able to teach him.

He became a newsboy on the Grand Trunk Railroad. After he had been selling papers for a little while he decided that he would publish a paper of his own and sell it also. Thomas had always been very eager to learn new things. He liked to know how different kinds of work were done. He was watching the printer of a paper one day. The printer admired the young boy for his interest in the work and gave him some old printing presses. These Thomas put into use as soon as he could. It was these old presses that he used in publishing his own little paper, and he was very happy when he found that sometimes he was able to make as much as forty-five dollars a month from the sale of it.

For a poor boy this was a great deal of money, but Thomas was not able to earn it for a long time. He had been in the habit of using a corner of the baggage car to work out problems in chemistry when he was not busy with his papers. He had acids and other chemicals which he mixed and treated in different ways.

He was working with some phosphorus one day when he upset the container and the phosphorus took fire.

The conductor put out the fire, but he was very angry. He threw out what was left of Thomas Edison's chemical supplies. He threw out of the car what was left of Thomas's printing presses. Last of all he threw out poor Thomas himself.

The boy then had the problem of finding new work, but he soon solved this. While he was still a newsboy he had saved the life of a little child by snatching him from the path of a moving train. The father had been very grateful to Thomas Edison and had taught him telegraphy as a reward for his brave act. When Thomas lost his chance to sell papers on the trains of the Grand Trunk Railroad he decided to earn his living by becoming a telegrapher, and this is what he did. He became an expert telegrapher, but he left this work in time because he liked inventing better than anything in the whole world.

When Thomas Edison was twenty-one years of

age he invented an electric machine that could be used to count votes. At the same time he also invented another electric machine called the stock ticker. With this machine prices of stocks could be printed upon paper tape. For this invention Mr. Edison received forty thousand dollars (\$40,000). This was such a large sum that he could scarcely believe that his work was worth so much.

Some boys would have stopped working if they had earned such a large amount of money. Mr. Edison was glad to have the money because it helped to make it possible for him to give up his whole time to the work of inventing. Not long after he had received this first large check he built a laboratory near Newark, New Jersey. In this shop he spent his time working out new inventions. Later he built two four-story buildings at Orange, New Jersey, where many of his famous inventions were first tried out.

One time he spent sixty hours at work upon a problem. During this time he ate nothing but crackers and cheese while at his work bench.

At another time he remained in the laboratory for five days and five nights. During this time he would sleep only when one of his helpers took his place, and then he did not sleep long. Mr. Edison's eyes grew weak from looking at the brilliant glow of the electric light which he was studying. During the last two days and nights he ate nothing, but at the end of the five days he had almost solved the problem that he was trying to work out about lighting with electricity. Later he was able to get just the kind of light he wanted.

Mr. Edison liked the idea of taking pictures of sounds with the phonograph which Mr. Scott had learned to make. He was glad when he himself had found a way to do this better than it had been done before. What he wanted next was to find a way in which to make the pictures of men's voices talk or sing.

With this in mind he set to work. Sometimes he worked all night as well as all day. One day, after he had spent many hours in study upon the problem, he suddenly jumped up and said with great

eagerness, "At last I can make a talking machine!" Then he sat down and drew the plans on a piece of yellow paper, and gave them to his foreman, who made a model for his employer. Mr. Edison hardly dared hope that the machine would work. He spoke into it the four lines of the rhyme that every one knows:

"Mary had a little lamb,
Its fleece was white as snow,
And everywhere that Mary went
The lamb was sure to go."

Then he moved the parts that should be moved and waited to see if the words would come back to him. This is where he thought that he would be disappointed, for no machine had ever been made to do this before.

To Mr. Edison's surprise, *his own words came back to him:*

"*Mary had a little lamb,
Its fleece was white as snow,
And everywhere that Mary went
The lamb was sure to go.*"

To be sure, the words sounded a little harsh and indistinct, as if they were being heard from a distance, but they could be understood, and Mr. Edison knew that his problem was at last solved. The only work left to do was to make the new machine talk and sing better.

Mr. Edison named his invention the *phonograph*. The words of "Mary Had a Little Lamb" were the first that were ever heard from this kind of machine, but we are glad to know that they have not been the last. Since that day hundreds of men, women, and even children have had pictures taken of their voices. The wonderful machine can talk and sing clearly now, and with a sweet tone that is pleasant to hear if the speaker or singer has this kind of voice.

With the help of the phonograph thousands of people have heard the singing of great musicians like Caruso or Galli-Curci. Words of well-known statesmen like Woodrow Wilson have been heard too. Funny sayings have come from the lips of Mark Twain himself. There are rhymes or songs

of school or play-time for the young children, and the national airs like " My Country 'Tis of Thee " or " The Star-Spangled Banner," which all children like to hear.

The phonograph which we have to-day is very different from the first machine made by Mr. Edison in 1877. Other men have spent time and money in trying to make it better.

In the first machine the sound pictures were made upon tin-foil. Through the work of two other men, wax cylinders came into use, and these could be made to do better work. Other changes have been made from time to time until we have to-day the well-made machine that talks and sings with such clearness and beauty.

People enjoy the music so well that thousands of phonograph records are being made every day, and in Mr. Edison's plant alone a whole building is given up to this work. This building is always a very busy place. In one room a man laughs and jokes before a large tin horn. The horn is a part of the big machine which is taking pictures of the

man's voice to be made into records that will give out the sounds again at some future time. In another room two women may be singing a duet, a hymn, or a song from an opera. In still another room a woman may be telling a bedtime story which children will be making their phonographs repeat to them at some future day.

Some children have studied history and know many things of interest about George Washington. Think how wonderful it would be to be able to hear the first President's Farewell Address in his own voice! Or Lincoln's Gettysburg Speech! What child would not like to hear this speech in the voice of Abraham Lincoln! Pleasures like this will be enjoyed by the children of the children who are living to-day, because many of our great statesmen and patriots are having records made of their speeches. Most of the great musicians are leaving records of their work for the phonograph to reproduce in years to come.

Perhaps some child who is reading this book will have a record made of his voice at some future time.

If this is true, it will be with the help of the phonograph, the wonderful machine that talks and sings for us.

BUILDINGS THAT COULD HOLD THE PEOPLE OF A CITY

ONE day, a little more than thirty-five years ago, a great hurricane blew across the city of New York. People everywhere were frightened, but none were more alarmed than those who were around the new Tower Building. This building was still unfinished, and was to be the first skyscraper that had ever been built in New York City. The steel walls of the thirteen stories were up, and the roof was about to be put on when the great gale struck the city.

People had been afraid of the new building from the very beginning. "It cannot be made safe," many said. "It is nonsense to try it," the man who had charge of one of the big newspapers wrote. When the building was about to be started, the owner came to Mr. Gilbert, who was the architect in charge of the work. "It is not too late to stop the



THE ZR APPROACHING THE WOOLWORTH TOWER

work," the owner said. "Perhaps we are risking too much after all."

Mr. Gilbert was sure that the building could be made safe. He had figured out just how much weight each part would have to bear, and how strong it could be made. Then he showed the figures to the owner, who told him to go ahead with the work.

When the great hurricane struck the city, the building was all ready for the roof. People who were on the streets near by hurried to get out of reach of what they thought would soon be a terrible mass of falling steel. Even the janitors and watchmen of near-by buildings left their work to get well out of the way.

Mr. Gilbert had a friend who believed in the strength of the new building, and with this friend he climbed the ladders which stood against the unfinished walls. The friend went only as far as the tenth story. The architect went on until he had reached the thirteenth floor, which was the top. Here the gale was so strong he could not even stand

up. He had to crawl on his hands and knees. People who were watching, turned their faces away. They thought the building would surely be blown to the earth and the two men with it.

Mr. Gilbert held on tightly to the steel frame. Then he dropped the plumb line which he had brought with him, and found, just as he had thought, that the building had not been moved by the strong wind. It was standing as firm as a rock.

The gale blew long and fiercely that night, but the Tower Building was not injured. The man who had planned the work had proved to the people that the new skyscraper could be made safe.

Since that time there have been scores of other skyscrapers built within the city of New York, and many in other cities. It may be that you have read of the Singer Building or the Metropolitan. And who has not heard of the Woolworth Building?

The Tower Building, which was the first skyscraper in New York City, was made to reach thirteen stories, or a hundred and sixty feet in height. The Woolworth Building reaches *sixty*

stories, and is *seven hundred and ninety-two* feet in height. There were no fears while it was being put up, and even when the strongest gales are blowing, people do not hurry away from it. Every day ten thousand people are at work within the walls of this great building,—as many people as may be living in your town or city. Ten thousand people is even more than live in most towns and suburbs.

These people do not stay in the Woolworth Building all of the time. Most of them hurry away on the subways, elevated trains, and ferries at night. A few men, who have no other homes, live in the building all the time, and there would be room for more to do so if they wished. People could stay in the building and have all they needed for a long time. There are restaurants, rooms in which clothing is sold, barber shops, news-stands where papers and magazines can be bought. There are even mail-chutes, so that the people do not have to go to the post-office or to a street-corner to mail a letter. They have only to put the letters into a glass tube

through which they fall into a mail bag in the lower part of the building.

If one wishes to send a telegram or cable message, he has only to press a button and a boy appears. The boy will take the message to the men who have charge of sending them. Telephones are found about the building for those who wish to make use of them.

There is electricity for lighting, and steam to heat the rooms in cold weather. Electric elevators carry the people from one floor to another. Some of these are express, and stop only at certain floors. All of them are made as safe as possible. Even if an elevator should happen to fall from one of the upper floors of the building, it would carry the passengers to the ground floor quietly and easily. This is because of the air cushions which stop the fall of the car and make it impossible for it to fall to the bottom of the elevator shaft with a crash.

If you are ever in New York City and can spare fifty cents of your spending money, take the elevator ride to the top of the Woolworth Building and

look out upon the country round about, or upon the streets of the city. One elevator will take you up fifty-six stories. A shuttle elevator will take you the rest of the way to the tower, far, far above the streets of the city. You will see the people away down below, and they will look like tiny ants rushing about in their busy way. It will be quiet at this height too. The noises of the streets do not reach the tops of the tallest buildings. You can look far out upon the waters of the bay too, and can see the Brooklyn Bridge, the Statue of Liberty, and many other sights that you will remember for a long time.

While you are standing so far above the ground, a strong wind will be blowing against you as if it would like to blow you over the railing that has been built around the edge of the tower. You will either be frightened, or you will enjoy the fun and will want to stay until you have seen everything.

Some children are very brave while up on the Woolworth Tower. Others are not so brave, but all agree that the Woolworth is a very wonderful

building, and that the men who have planned and built the skyscraper have done a very wonderful piece of work.

When you have seen the tower and the inside of the Woolworth Building, and have admired these parts, you may be surprised to hear that the hardest work is not the building of the walls of steel, nor the many hundreds of windows, nor even the tower. The foundation below the level of the street has to be planned and built with the greatest care.

The men who built the Woolworth Building sank the foundation through one hundred and fifteen feet of sand in order to reach the solid rock beneath. Sixty-nine piers rest upon the rock. The piers are made strong with concrete. Pine trees from two acres of a southern forest were used to make the piers, and many tons of concrete were used to make a strong and firm foundation for the great building. When we think of the thousands of tons in the upper part of the building we can see why the foundation would have to be made very strong.

The frame of the skyscraper is made of steel.

This is lighter than a frame of masonry which was once used in all buildings. The steel is cheaper too, and takes up less space so that the owner of the building can have more room to rent and can earn more money.

The outside of the Woolworth Building and of many other skyscrapers is marble, stone, or terracotta. The men who now plan the building of the great skyscrapers are trying to make them better looking than they used to be made. The Woolworth has a church-like tower for a part of its upper stories. This makes the building more beautiful. Some of the skyscrapers have not been made to look so well. "They are like huge chimneys," foreigners often say when they visit New York for the first time. This is true of many of them. Others are being built with decorations of different kinds that make them look wider and more pleasing to see.

Some one may be wondering why so many skyscrapers have been built in New York City. One reason is because land costs a great deal and is taxed very heavily. Men build high up into the air be-

cause it is cheaper to do this than to make the buildings spread out at the bottom where land costs so much. Although the skyscrapers are worth millions of dollars, the men who put them up get their money back in a short time. Mr. Woolworth had his building paid for within thirty days after it was finished. People are always looking for office room in new buildings that are within reach of trains and boats.

If you are in New York City and cannot get a view from the tower of one of the skyscrapers, try to find some men at work upon one of these new buildings so that you may watch them. "They are built over night," some one has said. This is not really true, but there are men who work upon the buildings in the daytime, while there are other shifts of men who work during the night. This is done so that the building may be ready for renting within as short a time as possible. Some of the largest are all ready for use within a few months because of the work that is done at night as well as in the day.

BUILDINGS THAT HOLD A CITY 133

Skyscrapers are being built more quickly than they ever were before. More and more of the large cities are making use of this kind of building too. Men have found that they are safe and very useful.

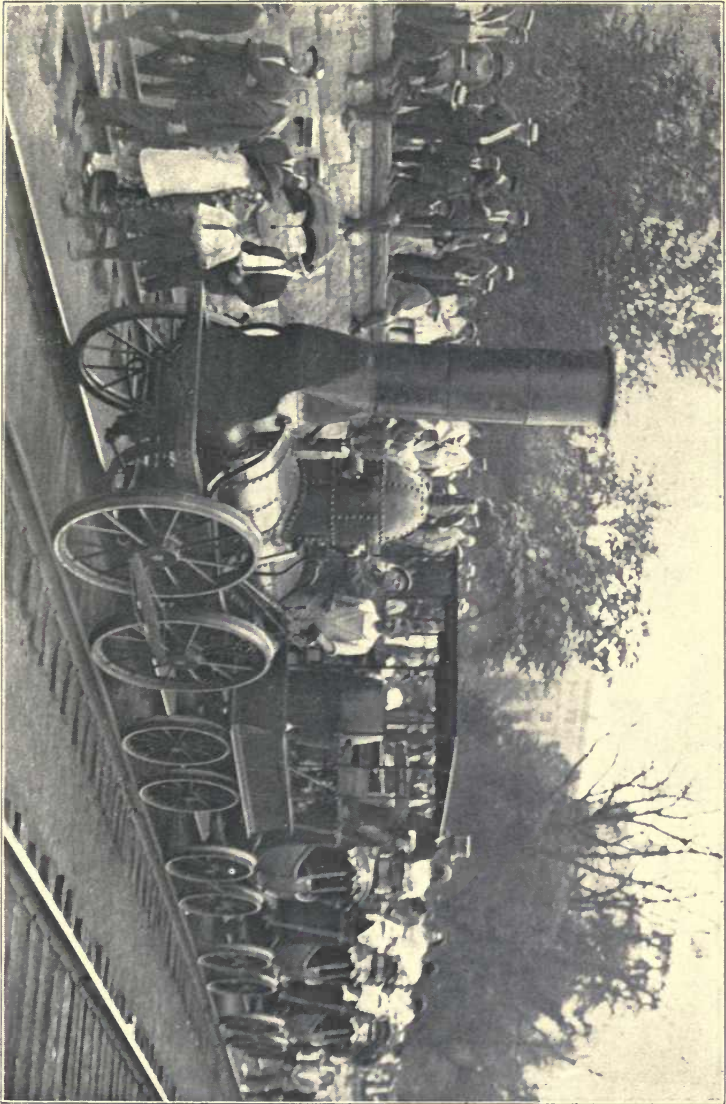
HORSES MADE OF IRON.

DID you ever take a buggy ride with an old horse to pull you along at a steady gait? If the weather was fine, it was pleasant to jog along a country road that lay between fields of ripening corn or blossoming clover.

Most children have had rides of this kind and have enjoyed them. There was a time when there were few other ways in which a child might ride unless he chose to go astride a horse's back or in a wagon.

To-day we have automobiles or street-cars and electric trains to take us about from place to place. Best of all, we have the railway trains that are pulled by the great locomotives which carry us along at a great speed, sometimes as fast as a mile a minute.

The locomotives have been called "Iron Horses,"



"THE DEWITT CLINTON," THE FIRST NEW YORK LOCOMOTIVE

which they really seem to be. Like horses they need to be fed,—not hay or oats, but great lumps of shining black coal. Tons of this strange kind of food the “Iron Horse” consumes each day, and gallons of water.

While his great appetite is being satisfied, he is ready for work. With a roar that can be heard near and far, he rushes along, pulling behind him heavily laden cars of freight, or passenger coaches carrying hundreds of people. He will hurry along over thousands of miles, or will stop if his master, the engineer, wishes him to do so.

The “Iron Horse” is never told to “*giddap*.” A lever is moved, and this gives the great beast the signal to go on at a certain speed. For another speed a still different lever is used. When the engineer wishes the “Iron Horse” to stop, he works a brake and the train is soon at a standstill.

When the train is made up of passenger cars, people alight at each stopping-place and the great “Iron Horse” stands panting and puffing as if he were out of breath. When the great number of

passengers are seen to alight from the train, and the scores of heavy trunks and suitcases are unloaded from the baggage car, one is surprised that the "Iron Horse" does not pant and puff even more than he does.

This is where the horse made of iron is different from a real horse. He is made to use the power of steam, and can do a greater amount of work than a real horse could ever be made to do.

The "Iron Horse" is unlike the real horse in other ways too. Some real horses know the roads along which they must travel. The driver has only to rest the reins upon the animal's back and he will reach home in safety. Many horses will stop and refuse to run over an obstacle that may lie across their path.

It is not so with the "Iron Horse." He will run over anything that crosses his path unless his master, the engineer, works the brake that tells him to stop. At certain places signals must be given the engineer to tell him when the track is clear, or when the "Iron Horse" must be made to stop un-

til he can go ahead in safety. This is always true at terminal stations.

At the terminal of one of the railroads at Jersey City there are ten tracks from which trains leave during the day and night. Leading to these are four main tracks. This part of the terminal is like a huge bottle, with the four tracks forming the neck and the ten tracks the bowl. Hundreds of trains must use the four tracks leading from the terminal each day, and there must be no delay or danger to passengers who are riding in the trains.

To keep the trains moving along with safety and on time, men in the tower overlooking the tracks spend their time giving signals to the engineers. With the use of levers worked by electricity, semaphores are raised or lowered just as the man in the tower directs. These semaphores are sort of arms that hang above the tracks,—high balls and low balls, the engineers call them. When the arm of the lowest semaphore, or low ball, hangs down, the engineer knows that he may go along with caution. When the arm of the high ball is lowered, the track

is clear and the engineer may pull into or out of the station without danger of collision. When the arms of the semaphores are at right angles to the posts, the track is being used and the engineer must wait until he is given the signal to advance. At night a red light says "Danger" when a track is being used. A green light means "Track Clear."

As may be easily seen, the engineer who allowed his "Iron Horse" to speed along without careful watching would learn something about a wreck in a very short time at a terminal station.

Engineers are very careful about noticing signals. They are always careful about keeping the "Iron Horse" in good working order too. Wrecks would occur more often if the locomotives were not cared for properly.

A real horse must be brushed or curried so that it may do its work well. An iron one has machinery that must be kept in good order and oiled often.

You have seen the engineer run along by the side of the locomotive with a long-nosed oil-can in his

hand. He is very careful to oil the parts that are in need of it so that they will work freely.

Like a real animal, the horse made of iron must have its time for rest too. He is driven into the roundhouse where he is put into a stall. If he has travelled a long distance, the fire in the fire-box is put out and he is left idle for a long while. After his rest, before leaving the roundhouse again, he is cleaned and polished and all of his parts looked over carefully. There must be no loose nuts or bolts to cause trouble on the road. There must be plenty of coal and water too, and dry sand in the sand-box. The sand is used on heavy grades, or wet, icy rails, to keep the locomotive from slipping. No engineer would care to make a long run without sand in the sand-box.

With so many locomotives in use to-day some children may think that we have always had them to work for us. This is not true. George Washington, the first President of the United States, never rode in a railway train because there were none in the country when he served as President, and there

were none in other countries. Some cars were made to run along wooden rails in mining regions. Coal was often hauled in this way. But it was not until the year 1829 that the first steam locomotive was used in the United States, and it had to be brought over from England because no locomotives were being made in this country.

This steam locomotive was called the *Stourbridge Lion*. It was a low, short locomotive with a tall smoke stack, and looked a great deal like the *Rocket*, which was the first good steam locomotive in the world.

The *Rocket* was made by an Englishman named George Stephenson, who was very proud of it, as he had reason to be.

The people of the United States who saw the first steam locomotive to be used in their own country were full of praises for it, as they too had reason to be. The *Stourbridge Lion* was much stronger than the horses that had been in use. It could pull a heavy load of coal that would have taken many horses a long time to move.

But what would George Stephenson and the people who praised the *Stourbridge Lion* think of the great locomotives and railways of to-day? The New York Central carries passengers over nine hundred and twelve miles, from New York to Chicago, in twenty hours or less. The Imperial Limited, which belongs to the Canadian Pacific Railroad, can go from the Atlantic to the Pacific Ocean in only four days' time, a distance of more than three thousand miles!

Stephenson's *Rocket* weighed only seven tons. One of the largest locomotives now belongs to the Erie Railroad in the United States and weighs *four hundred tons!*

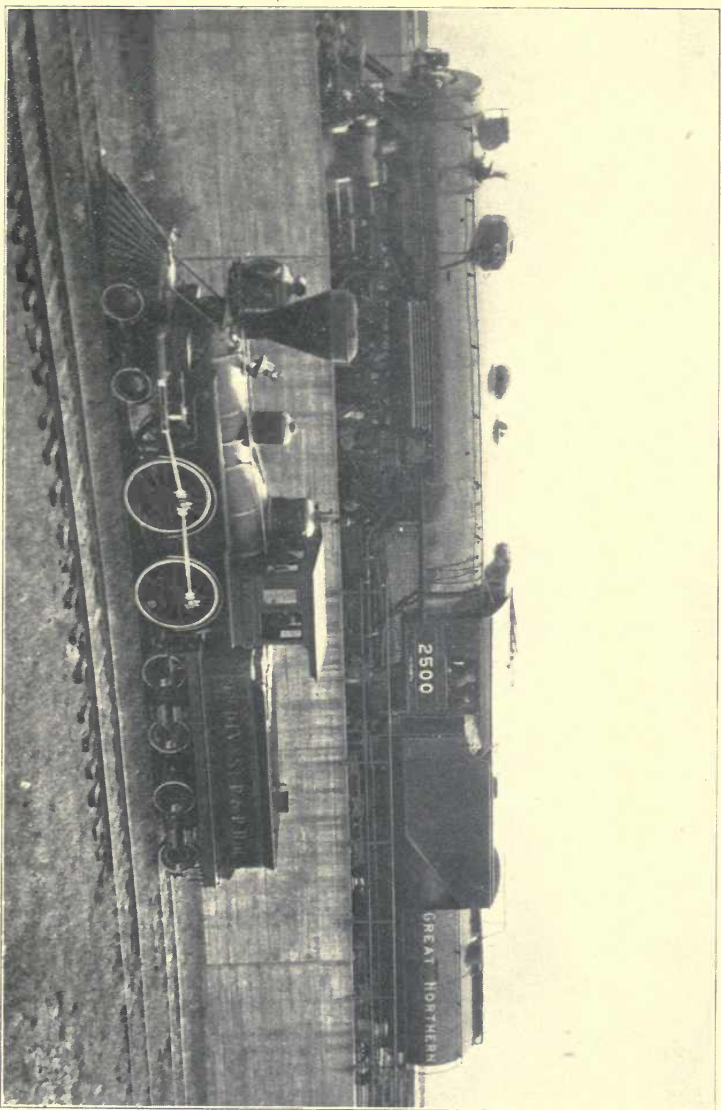
This great monster has already pushed *two hundred and fifty loaded cars*, and it could be made to move as many as *six hundred and forty cars!*

The coaches are being made more and more comfortable too. The first railway trains had no tops at all. The people sat upon seats in the open air, so that the dust had a merry time getting into eyes, ears, and noses. The wind had a way of trying to

blow off children's hats or carry loose papers high into the air. The faster the train went, the more mischief the dust and wind could do. People became very impatient about all these inconveniences, and every one saw clearly the need of a different kind of car. At last covered coaches were made and put into use.

To-day the coaches are very, very comfortable. There are cozy chairs covered with plush, and clean beds for those who must travel at night. The dust and wind have no chance to play their mischievous pranks because the coaches are all covered, and upon the windows are screens of a kind of fine wire through which the dust and wind find it hard to force their way.

Most of you have ridden in coaches of this kind. You may have had a meal or two in the dining car and you know what good food may be had there. Perhaps you have sat upon the platform of the observation car, which is the last car of the train. It is fun to watch the tracks that seem to be running away from the train as fast as they can; and there



THE FIRST AND LATEST LOCOMOTIVES OF THE NORTHWEST

may be beautiful lakes, woods, mountains, or valleys to be seen upon either side.

If it were not for the locomotives, the western part of our country might be little known to-day. Before railroads were built it was a long journey across the country to the west, and it was a dangerous one. The Indians were unfriendly and warlike. They did not like the white men to get a footing in their part of the country.

With a mighty whoop, a swinging of tomahawks, and a whizzing of arrows, the Indians would rush upon the men in the dead of night, or would spring out from behind an embankment. If they could return to their camps with the scalps of white men in their belts, they were very happy. Many a white man who dared to make the trip into the western part of our country never returned to his home again.

Now people need not fear to make this trip. Many railroads have been built, and towns and villages have sprung up from the East to the farthest Pacific Coast regions. Day after day

great locomotives carry trainloads of passengers and freight from one part of the country to the other with no fear of surprise attacks from hidden enemies.

And what a wonderful work is being done! The oranges that are ripened under California skies are served upon the tables of the people of New York and Chicago. Boots and shoes made in Massachusetts are worn by the children of Oregon. The people who live in the flat prairie states of Nebraska and Kansas can enjoy the beautiful mountain or wooded scenery of the East or far West.

With the help of the "Iron Horse" the people of the United States are like neighbors who can share their good things with one another.



BROOKLYN BRIDGE

AVENUES IN THE AIR

THERE was great excitement in the cities of New York and Brooklyn on the twenty-fourth day of May, 1883. The streets were crowded with people who were eagerly pressing their way toward the East River that lies between the two cities. The people seemed to be happy too, while everywhere gay-colored bunting decorated the buildings, and the sounds of bands could be heard playing military airs and marches.

Before the sun was high enough in the heavens to show that the noon hour had come, the banks of the East River were thronged with people who shouted or waved their hats when a great parade came marching up to the river.

The parade was led by two military bands that played the most stirring music the people had ever heard—"Columbia, The Gem of The Ocean," "America," and "The Star-Spangled Banner."

Oh, how every one enjoyed the gay music! And the parade! What a sight it was! There were soldiers in uniform, many of them, and the President of the United States appeared, as well as the Governor and Lieutenant Governor of the state of New York. The Mayor of the city of New York was in the parade too, and other important men. Many of them were known by the men and women in the crowd, who cheered and cheered as they came along.

And why so many people and such important officers and well-known men in a big parade? It was the opening of the great Brooklyn Bridge upon which men had been working for thirteen years—the largest and best-made bridge in the whole world at that time.

Not only this. People who wished to go from Brooklyn to New York had been making the trip across the water on ferries which were becoming more and more overcrowded as the cities grew in numbers. In the morning and evening there were delays and discomforts which made the trips hard for every one.

With the opening of the Brooklyn Bridge a new way would be provided for the people to go back and forth between the two cities. It might even make it possible for the two places to be united in one larger city at a later day. It was no wonder that the people were gathered to celebrate the opening.

And what a beautiful bridge it was! From a distance it looked like a spider's thread, and its long, sweeping lines were very graceful to see. Like a real spider's thread the bridge was made to hang in the air. This kind of a structure is called a suspension or hanging bridge.

The great bridge hangs from four large steel cables which extend from the tops of the great towers. Each one of these cables is made up of more than five thousand steel oil-coated wires, and is almost sixteen inches in thickness. If you measure sixteen inches across your school desk, you can see how strong these cables had to be made in order to hold up the great steel bridge which weighs thousands of tons, and across which many thousands

of people pass each day, and many tons of freight are carried.

All of the people gathered together on that festive day in May were proud of the work that had been done. Most of them knew how to build a sort of bridge themselves. They knew how to throw a plank across a ditch or stream which is so wide that one could not make the opposite side with a leap or jump.

This kind of bridge is easily made, but the great Brooklyn Bridge made of steel and concrete was not easy to make. It would have to be used by millions of people as time went on, and it had to be made strong and large enough to carry crowds of people at one time.

The Brooklyn Bridge is larger than any plank bridge could ever be made, too. On that day in May a man said it looked like "an avenue in the air," and this is what it really is. Like an avenue, there are the street-railway tracks, the roadways for wagons or automobiles, and a sidewalk for those who must travel on foot.

The people who gathered to see the opening of the Brooklyn Bridge admired the work of the engineers and their band of helpers, for the bridge was a structure of great strength and beauty. The parts that were admired the most were the towers and cables and the long graceful lines of steel that made up the main part of the bridge. Most of the people were full of praise for this part of the work that could be seen above the water.

No doubt most everybody overlooked the most important part of the work—the part that always takes the greatest amount of skill and care in building any large bridge. This is the work that is done beneath the water.

If there happens to be no rock where the foundations are to be laid, the task is a very hard one. Sometimes a large caisson or cylinder with cutting edges is forced down into the muddy bottom of the river. This large cylinder is closed at the top but open at the bottom. Air is forced into the lower part of the cylinder with great pressure in order to keep the water from getting under the cutting

edges. In this lower chamber of dense air the men must work. Here they dig and even blast with dynamite until they have cleared the river bed of loose waste material and made a solid foundation for the concrete bridge towers.

It takes months to place one of the high cylinders, and then only the strongest men can stand the work in one of them. The pressure of the air is so great that the faintest taps sound like the blows of heavy hammers, and the voices of the workmen have a strange sound like harsh clanging metals.

When the bed of the river has been prepared by the men who work in the steel cylinder, the concrete foundations are made for the bridge towers. Some men have even lost their lives before this part of the work has been completed. The air in the caisson or cylinder tires and even injures men who breathe it for a long time. Mr. Washington Roebling who had charge of the building of the Brooklyn Bridge became very ill while directing the work in one of the steel cylinders under the water, and never became strong enough to walk upon the bridge

which he himself had helped to build,—not even upon the opening day when thousands of people were thinking of his great work and praising him for it. The building of the upper part of a bridge is a hard piece of work. Mr. Roebling knew this. He also knew that it takes greater courage to risk the dangers of the work under water.

The Brooklyn Bridge was a wonderful piece of work, with its towers that reach two hundred and seventy-two feet above the water, and its long lines of steel that seem to leap across the river for a mile and more. The bridge is high too. The masts of the tallest ships can pass beneath without touching any of it.

Since the bridge was opened there have been other large bridges built across the East River in New York. There is the Williamsburg, the Manhattan, and the Blackwell's Island. Many large and similar structures have been made in all parts of the world, with the same skill and care exercised in the building of Brooklyn Bridge. In spite of this, most of you have heard more about the Brook-

lyn Bridge. Perhaps you will wonder why this is. It is because it was the greatest in the world at the time it was built, and because it united two places which are so well known.

One could tell about many other great bridges that are in use now. There are the cantilever bridges. The Forth Bridge in Scotland is one of these. Perhaps your father or your teacher will draw a picture to show how this kind of bridge is made. It does not hang from cables like a suspension bridge. There are main beams, or cantilevers, which are supported by towers, with connecting spans in between. The Blackwell's Island bridge which crosses the East River in New York is another of this type, and the Niagara Bridge also. The Niagara is well known because of the disaster which occurred before it was completed.

This bridge was started in the year 1902. Three years later as many as eighty men were at work upon it one day when the bridge suddenly collapsed and fell into the river. Most of the men were killed, and fifteen thousand tons of steel were thrown into

a tangled mass which blocked the river all around. It was a sad day for many. Besides the loss of life, three years of work were wasted because the engineers who had planned the bridge had not made it strong enough.

Since that time the Quebec Bridge has been built again. It is a cantilever bridge, just as it was before, but it is so strong and well-made that it will never collapse and fall into the river.

Some people like arch bridges because they are so beautiful. There are many of these in the world. There is the London Bridge, the beautiful bridge which crosses the Mississippi at St. Louis, and the well-made arch bridges of France, Germany, India, and Siberia. Those of you who have geographies can name many more than these.

Then there are the bridges that may not be mentioned in your geographies. They are the ones that are still being used in parts of the world where the people are not far enough advanced to be able to build better structures.

Arched rocks carved by the wind and rain are

used in some places, and there are the logs that float down the streams, making rather uncertain bridges as they float along. Giant grapevines that grow across ravines are often used by primitive peoples too.

We who live in civilized parts of the world are fortunate to be able to use strong steady bridges—"avenues in the air"—upon which even automobiles and street-cars can travel in safety.

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