

CHILDREN'S SCIENCE SERIES

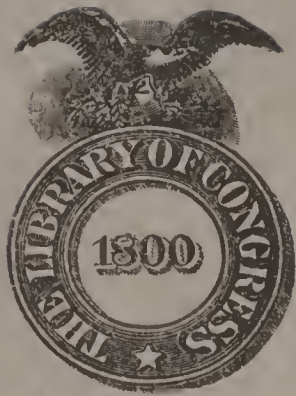
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THE  
LADDER OF  
CLOUDS

No. 1



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# THE LADDER OF CLOUDS



Federal Writers' Project, Pennsylvania

CHILDREN'S SCIENCE SERIES

THE  
LADDER OF  
CLOUDS

COMPILED AND WRITTEN BY THE  
FEDERAL WRITERS' PROJECT  
WORK PROJECTS ADMINISTRATION  
COMMONWEALTH OF PENNSYLVANIA

*JUNIOR PRESS BOOKS*

ALBERT  WHITMAN  
& CO

*CHICAGO*

*1939*

PE 1127  
S3C5

Federal Works Agency  
Work Projects Administration  
F. C. Harrington, *Commissioner*  
Florence Kerr, *Assistant Commissioner*  
J. D. Newsom, *Director of the Federal  
Writers' Project*



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PRINTED IN THE UNITED STATES OF AMERICA  
BY J. J. LITTLE & IVES COMPANY, NEW YORK

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NOV --2 1939



## NOTE

*The Ladder of Clouds* is the first in a series of children's science books prepared by the Federal Writers' Project of Pennsylvania.

This book was written by John F. Hausmann, Jr. under the supervision of Paul Comly French, State Director, and George B. Reeves, Assistant State Director, all of whom resigned before publication.

The illustrations are by Ethelbert Brown and the cover design by David Cain, staff artists.

CONRAD C. LESLEY  
*Acting State Director*



“CUMULUS CLOUDS FILL THE SKY WITH DOMES AND TURRETS.”

## Ladder of Clouds

John lay in the meadow in the late afternoon. His big brother Ned lay beside him.

Ned and John looked up at the clouds. The clouds formed and melted.

“Look at the billowy clouds and at the thin wispy clouds,” John said.

As they looked at the different clouds, the two boys saw that the thin, wispy clouds moved in one direction. The billowy clouds moved in the other direction.

Ned was studying about nature in college and John was much interested. He liked to have his big brother tell him about the things he had learned at college.

“As you see, there are many different kinds of clouds,” Ned said. “Each form is different. There are many kinds of waters. There are rivers, lakes, and oceans. There are thin clouds. There are high, rolling clouds. There are clouds that spread across the sky. These many types of clouds always float in their own special part of the sky.

“The thin, wispy clouds float high in the sky. The billowy clouds float low in sky. There are many different kinds of clouds that float between these low billowy clouds and the high, thin, wispy clouds.



“THE GOLDEN RAYS OF THE SUN STREAM OUT IN LONG, WIDE BANDS FROM A BROKEN CLOUD.”

“People now sail through the sky in airplanes,” Ned continued. “They find there are many different pathways in the sky.”

Just then they saw an airplane in the sky. It flew like a bird, up, up into the sky. The sun shone through the clouds. The people in the airplane were looking down upon the soft billowy clouds. They were looking down upon a world of clouds. John thought that he, too, would like to look down upon a world of clouds.

Ned rose, brushing the grass from his trousers and saying, “Let us go in the house. I have pictures of the different kinds of clouds.”

When they reached the house Ned said to John, “Before seeing the pictures we will first go into the kitchen.”

John followed, wondering what Ned would show him there.

In the kitchen there was a kettle on the stove. The water in the kettle was boiling. Steam came out of the spout and mixed with the air. When it mixed with the air it became white and rolling and then it could be seen. This steam looked like small clouds in the air.

“See how the steam rises and melts in the air,” Ned pointed out to John. “That is just what happens to the clouds in the sky. The clouds form and they melt away.”

“What happens to the water in the teakettle when the water boils?” John asked Ned. Ned lifted the cover. They looked into the kettle. They had to keep their faces away from the steam, for the

steam might burn them. They saw that the water bubbled and jumped around.

“How do the bubbles turn into steam?” John questioned.

“Watch the bubbles,” Ned said. “See how they become crowded in the kettle. They have no more room in the kettle, and they have to come out. They finally rise out of the spout.



“THE WATER PARTICLES BUNCH TOGETHER. AND WE HAVE MIST.”



“These bubbles coming out of the spout do not look like the bubbles in the kettle. They have been changed into small water particles. These small water particles can hardly be seen. The air outside the kettle is cold. The cold makes the tiny drops of water particles come together. As they come together they look thick and white. That is steam.

“We cannot see the steam until it mixes with the air and then it is called Vapor.

“Imagine that you have a microscope stronger than any microscope that has ever been made. If you would look through this microscope you would see that the air is made up of thousands of gas and dust particles.”

Ned continued, "The water particles have to push in amongst all those other particles. The air particles are colder than the steam or mist. When air is cold it is heavy. The cold, heavy air presses on the steam and breaks it up. The steam becomes broken up into single water particles.

"Each single water particle rests on a dust particle. The dust particles with the water particles on them float around in the air. The water particles are so small they cannot be seen. The steam has disappeared. We say the steam dissolved in the air.

"See," Ned said, turning to the window and pointing to the sky. "That is just what happens to a cloud in the sky when the cloud melts away.

“The same thing that happens to the water in the kettle happens to all water. When water gets warm, the water particles on top get excited and jump like flying fish into the air. Some water particles fall back into the water. Other particles remain to float around in the air.

“Wherever there is water, the water particles rise into the air. We see wet clothes. As the clothes dry the water particles rise into the air. There is a garden hose spraying the lawn. The water on the lawn will become warmed. The water particles will rise into the air. Even the drops of sweat on your forehead will change to water particles. Anything at all that is water can evaporate or melt away.”

“Is the dew that we find on the flowers

in the morning a kind of water?" John asked.

"Yes," answered Ned, "and it is formed in an unusual manner. There is no rain. Nothing falls from the sky. First the grass and bushes and flowers are dry. Then when the sun goes down they become covered with dew. When the sun goes down the ground becomes cooled off. Then the air next to the ground becomes cooled off. The cool air drops its water particles.

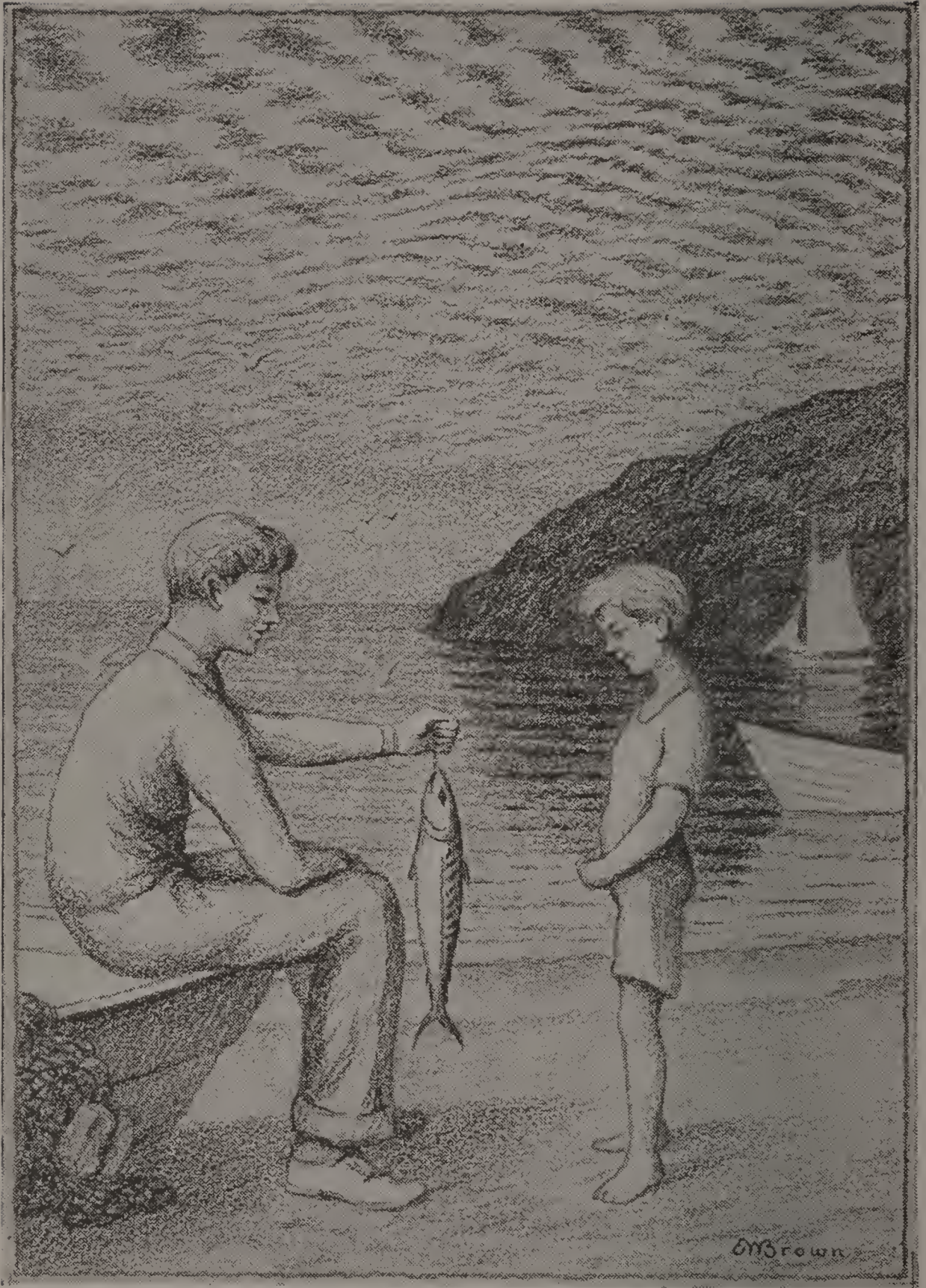
"There are three things we must remember. First, cold air moves slower than warm air. Second, because the cold air moves slowly, it cannot carry so much water. Third, the cold air must drop some of its water particles. That is the way dew forms."

“What happens to the dew?” John asked.

“The grass and flowers drink some of the dew,” Ned explained, “but still some of the dew is left. When the sun comes out we can see the dew sparkle on the ground. The sun warms the air. The water particles jump out of the dew droplets. Back fly the particles into the air. And again the water particles float around unseen. This has been happening year in and year out, since the beginning of the world. Always the dew formed and the sun dried it.”

John listened filled with wonder as Ned continued.

“It takes millions of water particles to make a cloud. Where do those millions of particles come from? The water



“SOMETIMES THEY LOOK VERY MUCH LIKE THE WAVES WE SEE AT  
THE SEASHORE.”

particles jumping out of the ocean would make the ocean dry in about two thousand years. But the rain falls from the clouds. The rain waters rush back into streams and rivers. The streams and rivers flow back into the ocean. Out jump the particles from the ocean. Again the particles dance in the sunlight unseen.”

“What happens to the particles when night falls?” John asked Ned.

“When the sun goes down in the evening,” Ned answered, “the wind lifts these water particles that dance over the ocean. The wind sweeps them away. Laden with the water particles the wind comes to the land. The ground is cool and it has been cooling the night air. The wind rushing in with all these water

particles is now cooled off. The wind drops some of the water particles. The water particles bunch together. And we have mist." Ned paused in his talk.

"Oh, I saw the mist last week. I could hardly see the trees or the houses across the street," John said.

"Yes," Ned answered. "Then the sun comes out and breaks the mist up again. In time all these water particles in the air make the clouds."

"But, how do they become clouds?" John wondered.

"Heat is the answer," Ned replied. "The sun warms the air. The warm air is very active. Now, if we could look through that powerful microscope we would see that the water particles and other particles bounce around. The

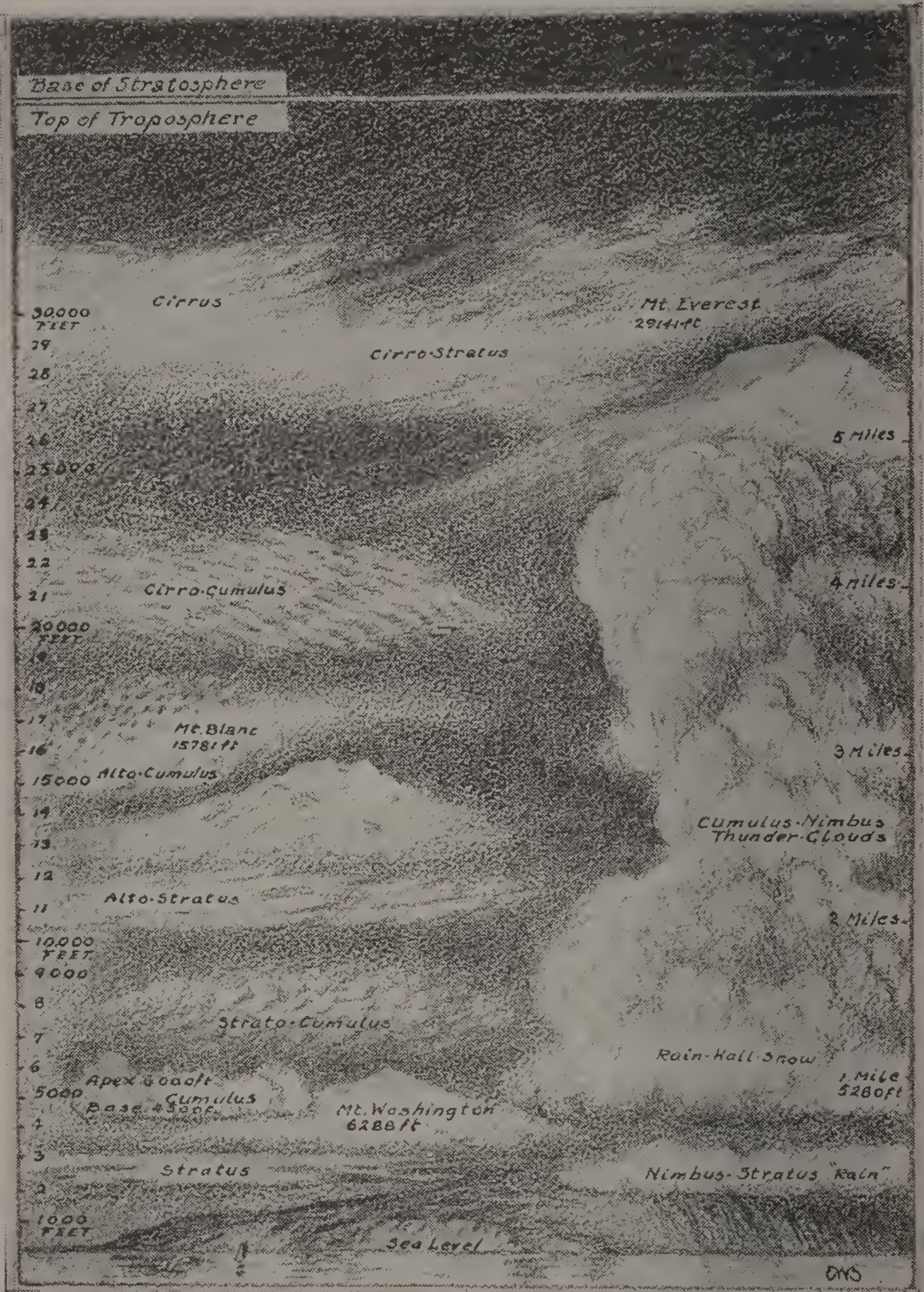


water particles are lighter than the air particles. They rise just as a balloon.

“The water particles go up and up. The air is colder higher up. The cold presses about the water particles. They crowd together and form clouds. We saw how the clouds melted in the sky. The clouds formed and melted. So we know that not all clouds become rain clouds.”

“I have seen the rain clouds many times before a shower,” John told Ned, “and I have often wondered what makes the rain.”

“It is a cold wind that makes rain,” explained Ned. “The cold wind cools the warmed-up air. When the warmed-up air with the water particles is cooled suddenly then clouds of heavy droplets form.

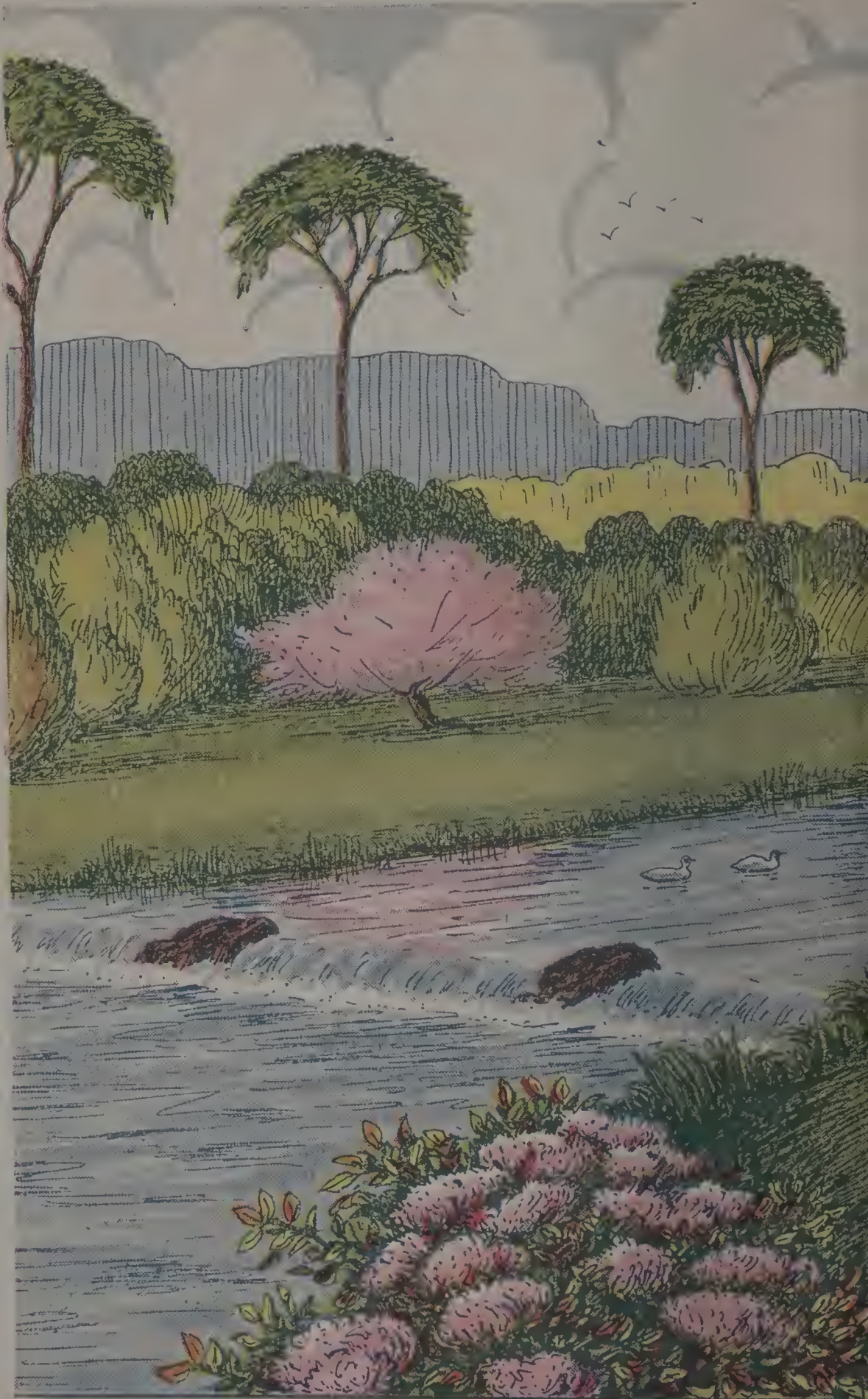


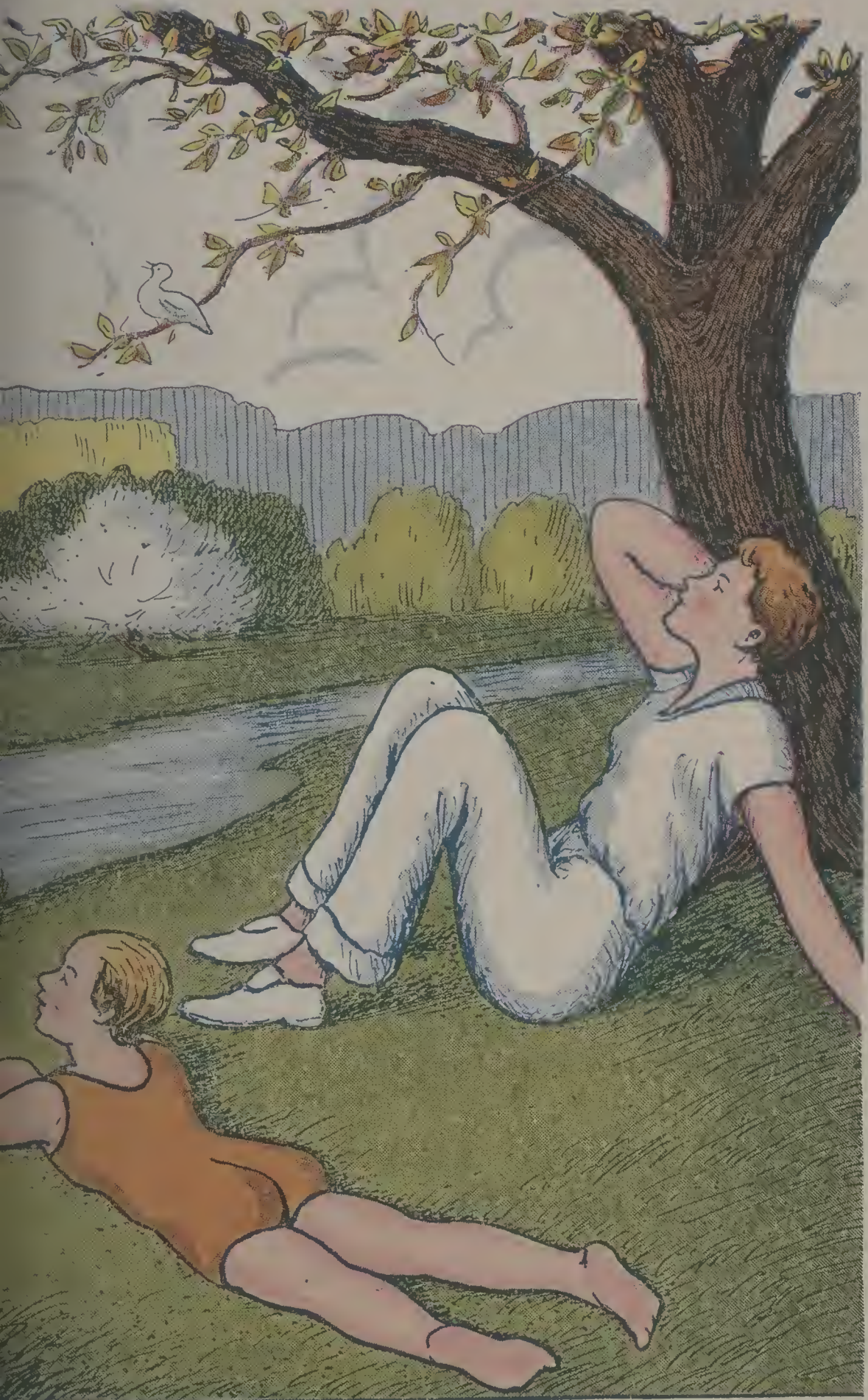
“THE CLOUDS FLOAT IN THEIR SPECIAL SPACES.”

“Rain comes down. The rain comes down sometimes in smaller, sometimes in larger drops. But the rain drops are never larger than the thickness of a lead pencil. If the raindrops are larger in size, they blow up into pieces. They burst like balloons.

“Now,” said Ned, “let us take an imaginary trip. We sail up, up, up, and the higher we go the colder it gets. The air stops getting colder about seven miles above the sea level. This is the end of the Cloud World.

“The air above the seven-mile level is always the same and never changes. The sky is divided into two parts. The lower part is the Cloud World where the clouds float. The upper part is the air above it. There in the upper part, the





air goes on and on and on until it comes to the Cloud World of another planet. Above the clouds the air is always the same and never changes.

“In the Cloud World the warmed-up particles rise easily. The air gets colder the higher up it is. The warmed-up particles rise and rise in this cold air. They rise easily because the water particles are lighter than the cold air above them.

“But this cannot happen in the air above the Cloud World. Here the air is always the same. Where the air is always the same the water particles spread out instead of rising. Also, no dust particles can rise in this air above the Cloud World. It is the many small dust particles that catch the sun's short rays.

“The dust particles make our beautiful light blue skies. In this air where there is no dust, the sky overhead is dark like the midnight sky. In this midnight sky the stars can be seen all day and all night long. It is always night in this air.

“In the Cloud World below, the clouds do not move any which way. The clouds float in their special spaces. The warmed particles rise on and on. The water particles stop only when they come to a Friendly Level. Only then do the water particles come together and form a cloud. Some particles form low clouds, others form higher clouds, and others form clouds near the end of the Cloud World. These water particles form clouds in the icy cold of the top of the Cloud World.”



CLOUDS SHADE THE EARTH FROM THE SUN, LIKE PARASOLS.

“Why do we have clouds?” John asked. “Do they have anything to do with us down here on the earth?”

“Clouds are very important to everybody,” Ned explained. “If it were not for the clouds we would have no food and the earth would be so hot that we could not live upon it.”



“The clouds in the sky serve as screens to us. The clouds come between the earth and the sky. If there were no clouds there would be no green growing things. The heat of the sun’s rays would shrivel and burn the plants and trees. The meadows and fields would be parched and dry.

“The clouds make the world beautiful. They fill the heavens with soft colors and shapes. The cloud mists are soft veils among the mountain tops.

“At night the clouds are like blankets tucking in the warmth.

“Now, let us look at some pictures of clouds,” Ned said, “since we have finished the story of how clouds reach the sky.”

Ned laid out his pictures. He laid

them one under the other like the rungs of a ladder.

"The clouds are divided into three groups.

"CIRRUS

"CUMULUS

"LOW CUMULUS"

"Tell me what those names mean," John asked Ned, "and I will write them down in my memory book."

"The highest are the Cirrus clouds," replied Ned. "They are the thin wispy clouds. They are made up of tiny pieces of ice. These ice pieces are so very fine that perhaps dainty fairies might use them for needles!

"Sometimes the Cirrus clouds look like long fibers. People call them mare's tails.

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“Sometimes these strands bunch up and they look like long, soft, white feathers.

“The Low Cirrus forms just below it. It is a light thin sheet of clouds. Some people call it the Cirrus Haze.

“The Low Cirrus sheet often forms wide rings around the sun and the moon. These rings are called halos.



SOME CIRRUS CLOUDS ARE CALLED “MARE’S TAILS.”



OFTEN FLEECY CLOUDS REMIND US OF A FLOCK OF SHEEP.

“Now, we come to the speckled and mackerel skies, the Cirrus Cumulus clouds.

“The Cirrus Cumulus clouds are dainty and delicate and white. They have hardly any shadows. Often they form in lines. Many times they form in waves.”

“What makes them form in waves?”

John wondered aloud. "Do they look like ocean waves?" he asked.

"Sometimes they look very much like the waves we see at the seashore," answered Ned. "And they form in waves because the currents of air pass one another. The currents of air passing one another do not flow all alike. Some flow faster. Some flow slower. As those currents of air flow they set up waves. All thin clouds may form in waves.

"The High Cumulus are the highest of the Cumulus clouds. They gather about two miles up in the air. They are the most beautiful of all clouds. They form the dappled skies.

"The dappled skies stretch across the sky in a host of small and medium-sized patches. Parts are gleaming white and

parts are softly shadowed. You can tell the High Cumuli from the Cirro Cumuli by the shadows.

“The Cumulus clouds are the billowy clouds. The Cumulus clouds often turn into storm clouds. If the Cumulus clouds form in the afternoon, the rest of the day will be fair. These billowy clouds fill the sky with domes and with turrets.

“If the Cumulus clouds form in the morning they may become a Cumulus Nimbus cloud. The base of these Cumulus clouds rests on a thick grey cloud. It is a dark flat Nimbus cloud. The Nimbus cloud is a rain cloud. From this base showers of rain fall. Often hail falls.

“Many times the Cumulus Nimbus clouds rush out of their places. They

climb higher and higher till they reach the roof of the Cloud World. Lightning flashes from these clouds.

“The Low Cumulus clouds are rolls of dark clouds. Many times in the winter they cover the whole sky.

“The Low Cumulus rolls break up with a change of weather. They have a torn, ragged look and make striking sunsets.

“The shining sky glows behind them. These clouds are lower clouds and fly from a quarter to one and a quarter miles above the earth.

“The tornado, like a fierce dragon of olden times, rushes out of a thick Nimbus. Its black, swirling tail lashes the earth. Its tail is cloud and dust. The tornado is like a tube. The tornado sucks up trees,

houses, people, and everything that is in its way.”

“I have seen pictures in the newspapers of the damage that a tornado does,” John told his brother. “How does it do such terrible things?”

“We call the tornado one of Mother Nature’s freaks,” Ned continued. “It acts just like a vacuum cleaner. The vacuum cleaner sucks up dust and small wisps of stuff. The tornado moves in a circular motion. Streams of hot air rush in on every side. The hot air takes the place of the air which is rising. It is a terrible swirl of rising air. Once it forms this terrible swirl it may last for only a few minutes or it may last for three or four hours.

“At sunrise and at sunset the clouds

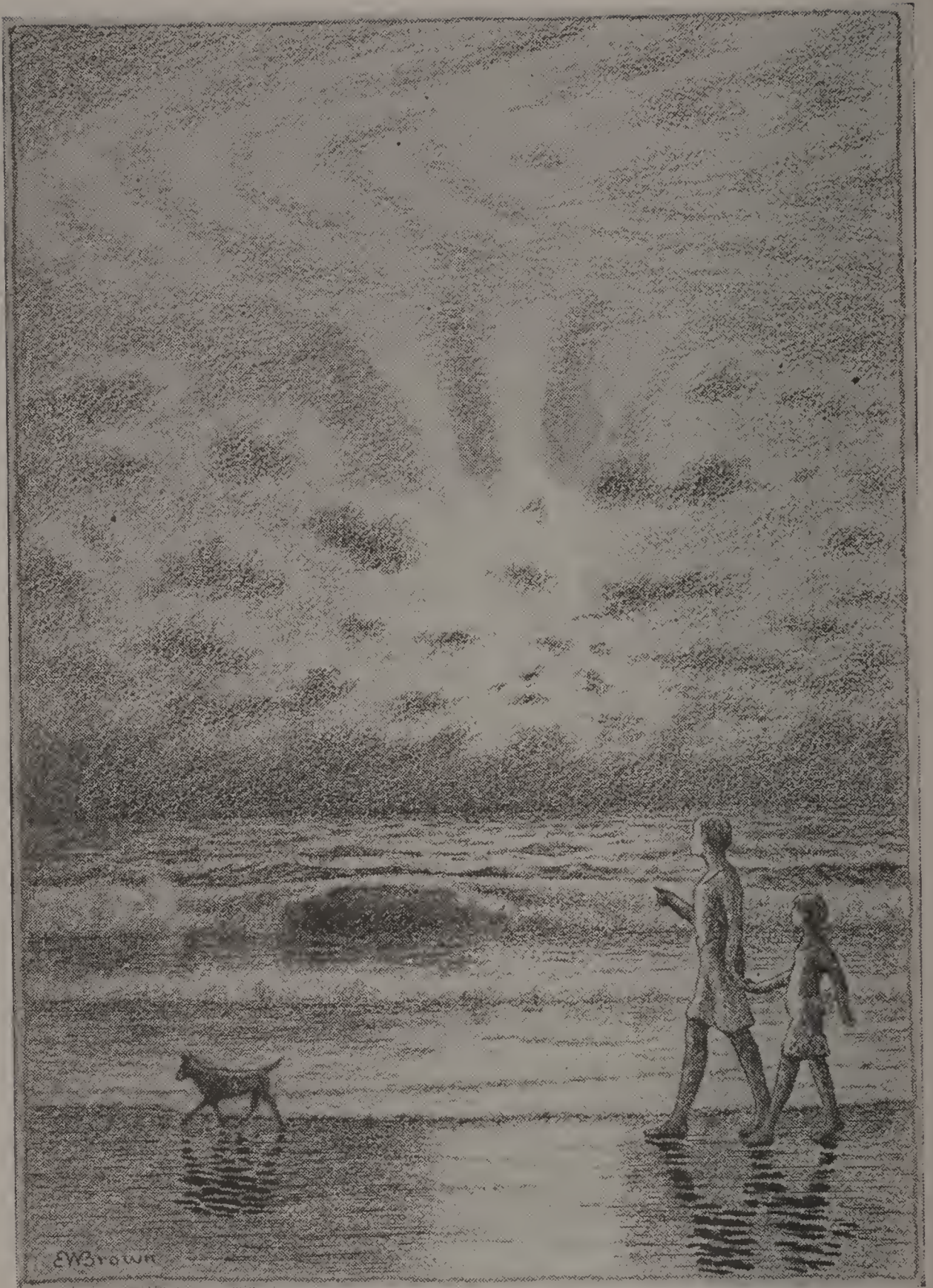




“THE TORNADO SUCKS UP TREES, HOUSES, PEOPLE, AND EVERYTHING THAT IS IN ITS WAY.”

glow like shining veils. They crowd around the sun as if they were singing songs of thanks to it. It was the sun that turned them into water particles. It was the sun that lifted them into the sky. Now, they group about the sun in the richest colors.”

“Where do all of the beautiful colors



“AT SUNRISE AND SUNSET THE CLOUDS GLOW LIKE SHINING VEILS.”

in the sunset come from?" John asked his brother. "I have seen sunsets that had so many colors that I could not count them all."

Ned explained, "It is Nature's three smallest things which make the glowing sunsets and the soft pearly skies. First there are the short light waves which later disappear; second the dust particles; third the water particles.

"The very short waves of sunlight would be just white light. They would be white light but for the very, very small dust particles. The dust particles dance in these white rays. The dust particles sift out the many colors that make up the white light. The water particles separate the colors from violet to red.

“We would not see the colors if it were not for the tiny water droplets in the clouds. The water droplets catch the colors. They hold them for us to see. The more dust there is the richer are the colors — gold and rose and red like fire.

“The sunburst is the most wonderful of all sunsets. The golden rays of the sun stream out in long, wide bands from a broken cloud.

“Even more wonderful than the sunburst is the rainbow. It arches across the sky. Purple, yellow, and red — it shimmers through the rain. It is seen only when you look away from the sun. Sometimes there is a double rainbow and the red and the purple change places.

“The rainbow glowing in the sky is not a solid thing like a tree or house. The

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different rays of light make the rainbow. Like a looking glass, the raindrops catch these colors, then throw these lights back into other raindrops.”

“Is there really a pot of gold at the end of the rainbow?” John asked Ned. “If there is, when I grow to be a man, I am going to try to find it.”



THE RAINBOW IS SEEN ONLY WHEN YOU LOOK AWAY FROM THE SUN.

“That is only a fairy story,” laughed Ned. “People like to say that there is a pot of gold buried where the end of the rainbow seems to touch the earth. There is not any buried gold and the rainbow does not touch the earth, but more wonderful than gold are the sun, air, clouds, and rain.

“All of these things help to make the rainbow and all of these things make the earth a green living thing.”



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